Malaysia Election Data Visualization Using Hexagon Tile Grid Map

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Abstract. Data visualization is an alternative representation to analyze complex data. It eases the viewers to identify the trends and patterns. Based on the previous literature, some countries such as United States, United Kingdom, Australia, and India have used data visualization to represent their election data. However, Malaysia election data was reported in a static format includes graphs and tables, which are difficult for Malaysia citizen to understand the overall distribution of the parliament seats according to the political parties. Therefore, this paper proposed a hexagon tile grid map visualization technique to visualize the Malaysia 2018 General Election more dynamically. This technique is chosen as the hexagon offers a more flexible arrangement of the tiles and able to maintain the border of the geographic map. Besides, it allows the users to explore the data interactively, which covers all the parliaments in Malaysia, together with the winning party, its candidate, and demographical data. The result shows that the hexagon tile grid map technique can represent the whole election result effectively.

Keywords: Visualization · Malaysia 2018 election · Hexagon tile grid
Map visualization

1 Introduction

Data visualization is the art of making people understand data by converting them into visuals [1]. There are a lot of ways to visualize data and each has their own advantages and disadvantages. Visual make the process of understanding a data much faster than text [2]. Most of the human brains make use of the visual processing because our brains are active towards bright colors [3]. It is much slower to read information rather than visualizing it. Therefore, with the help of visuals, human can understand the complex message of science [3].

Data visualization can be used to represent data in various domains including emotions [4], social network [5], election data [6], budget [7] and etc. For the political domains, the most significant user is the political figures and the public audience themselves. Data visualization could show the magnitude of passive voters from the voting-eligible adults in the 2016 Presidential election [6]. Other than that, political

figures could also target the public which does not know who to vote for from the visualization [8].

In Malaysia, most of the data are represented using tabular format [9], simple bar charts [10], and infographic [11]. These data include election data, population statistics, budget data, economic, financial statistics, gross domestic product, and etc. For instance, election data consist of multiple information including state, district, name of candidate, political parties, population, demographic data, and etc. It can be presented better using visualization. Therefore, most of the countries, like US [12], UK [13], Australia [14], and India [15] have presented their election data using interactive data visualization techniques.

This study aims to visualize the Malaysia General Election 2018 in a more dynamic approach. It will display the election result based on 222 parliaments in 14 states. This study will help the citizen to view the information at the first glance. It is also imperative for them to understand the election result through data visualization.

2   Reviews on Election Data Visualization

Data visualization is the art of making people understand data by converting the data into visuals [1]. Visual make the process of understanding a data much faster than text [2]. Data visualization is being used in multiple industries include the domains of politics, business and research. Since the study focuses on the election data and map visualization, the literature reviews are mostly reviewed previous studies in election related representations, which include United States 2016 Election [12], United Kingdom 2017 General Election Data [13], Australia 2016 Election [14], and India 2014 Election [15].

US 2016 Election Data Visualization [12] uses bar chart and map data visualization technique, as shown in Fig. 1.
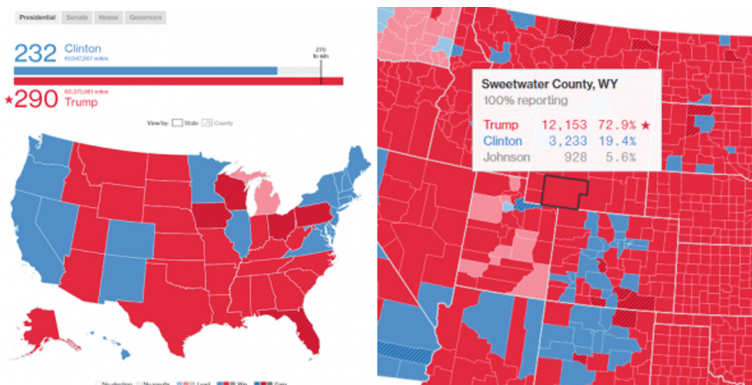

Fig. 1. US 2016 election data visualization

Bar chart communicates the most basic things of all election data, which is the Presidential votes and tally points. It shows the most important information for any election result such as the political stand for each of the political candidate. The simple color map visualization presents more granular data to reflect the results of Presidential vote. The map could be toggled from Presidential result to other representation such as the Senate, House and Governors result. The map also can be toggled from the state view to the county view. Moreover, even though the representation changes (Presidential, Senate, House or Governors), the visual shows the same layout and map types instead of using a different kind of representation for each of the categories.

United Kingdom uses a simple representation of the election data by showing the number of seats won, the actual number of votes and the percentage of votes domination by the political parties in UK. Then, the visual shows the dominance of the political parties by showing the number of seats as dotted square in the waffle chart and stacked bar chart [13], as shown in Fig. 2.
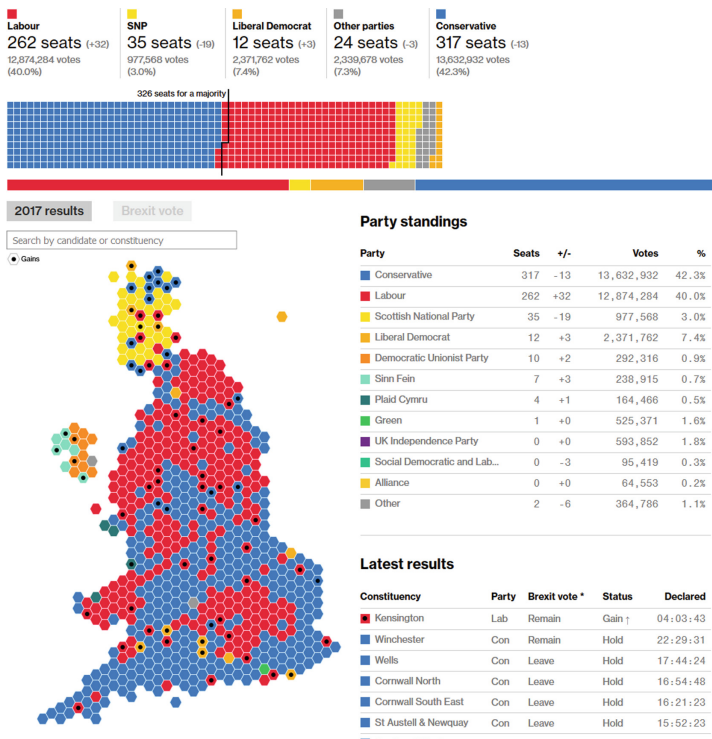

Fig. 2. UK 2017 general election data visualization.

A more detailed representation of the election data is shown by using the hexagon tile grid map and tables that present the status of each party and the political candidates. The hexagon tile grid map shows a semi-accurate representation of UK geographic map and each of the tiles represents the UK parliaments. The map is interactive, thus the

viewer can click on the hexagon tile, the table of party standing and status figures will show the list of parties and political candidates' status of that particular parliament. Moreover, when viewer hover over the hexagon tiles, the visual will pop up a figure showing the list of political candidates together with the party that they represents and the percentage of seats won by that candidate in that particular parliament.

Figure 3 shows Australia election data visualization [14]. Google presented the data visualization for Australia 2016 general election using Google Interactive Election Map. The map shows a choropleth representation of the election data based on Australia geographical map. The choropleth map is divided into sections according to the states in Australia. Each state is represented by different color that represents the political parties that had won the election on that particular state. For example, blue state means that Coalition had won that particular state. The map can be zoomed and panned. It is also interactive because the viewer can click on one of the states and a more detailed description of that particular state's political condition will be displayed in the detail sections at the left side of the visual. The section shows the overall result of the election by a stacked bar chart and a simple table of description. The stacked bar chart shows the overall result of the election by the percentage of seats won by the political parties. The simple table shows the political party name, the election candidate name and its actual winning seat number with the percentages.
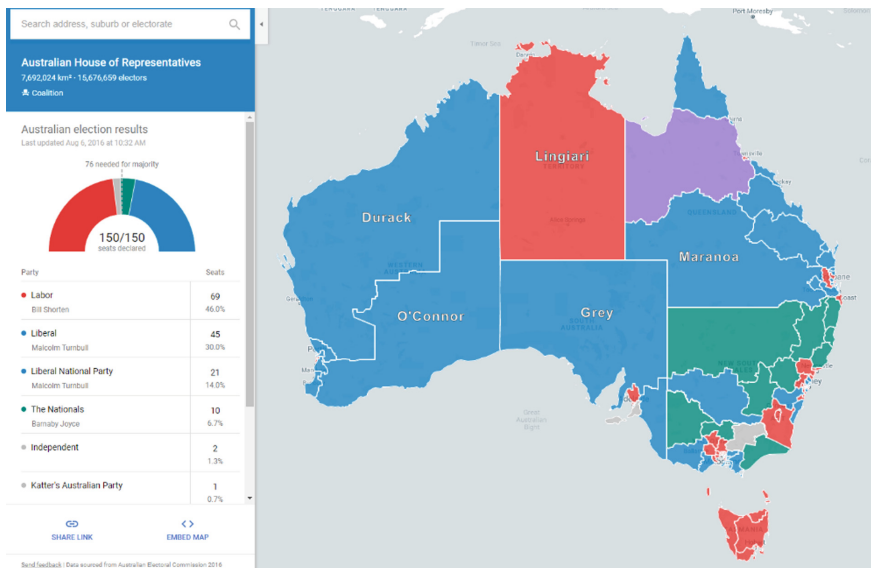

Fig. 3. Australia 2016 election visualization. (Color figure online)

India 2014 Election [15] uses data visualization for the election data, which a collaboration between Network18 and Microsoft India. The upper part shows a simple representation of the election data by presenting a stacked bar chart that shows the number of seats won by the political parties as a colored bar. It is easier for the viewers

to understand because it shows literally which party is dominating the election seats and indirectly tells which party is winning. The map section presents a choropleth map that highlight the States of India according to the color of the party. The map is interactive because when the viewer hover the mouse across the states, it will pop up a dialog message showing the name of the election candidate, name of party, name of the state and total votes won on that particular state. Moreover, when the viewer clicks on one state, a table will pop up on the top-right corner of the map showing the name of the election candidates, their party color, their party name and their total votes for that particular state [15] (see Fig. 4).
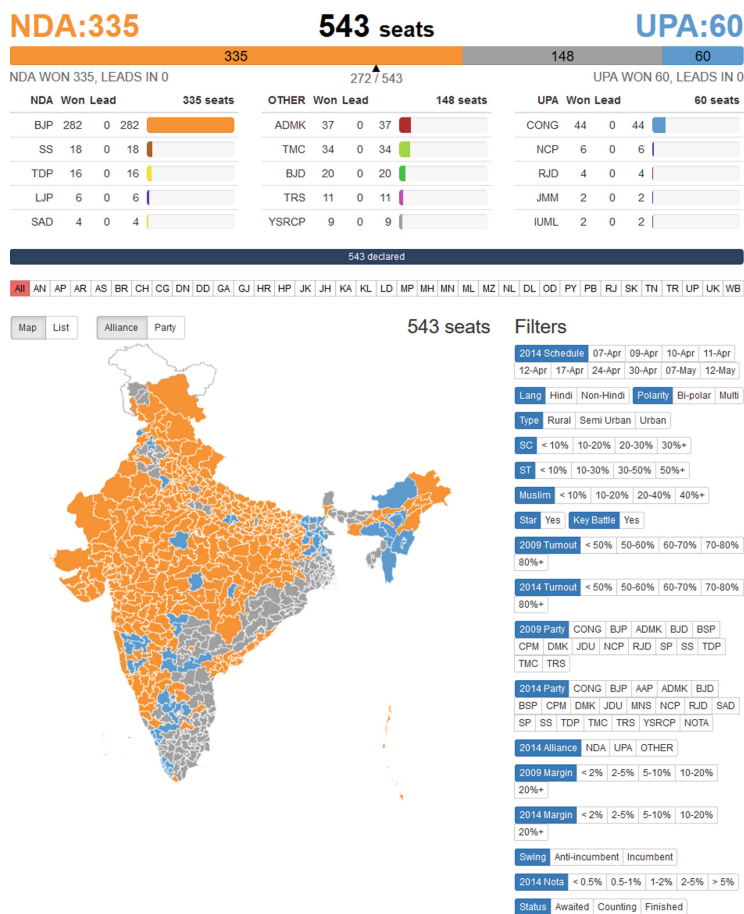

Fig. 4. India 2014 data visualization. (Color figure online)

From the literature, the following comparison table shows the summary about the data visualization techniques used in each election representation map (see Table 1):

Table 1. Comparison of election visualization techniques.

Country	Types of visualization techniques
US 2016 Election	Choropleth map, Stacked Bar Chart, Tabular Chart
UK 2017 Election	Waffle Chart, Stacked Bar Chart, Choropleth map, Diamond Tile Grid Map, Tabular Chart
Australia 2016 Election	Stacked Bar Chart, Tabular Chart, Choropleth Map
India 2014 Election	Stacked Bar Chart, Tabular Chart, Choropleth Map, Circular Tile Grid Map

Two simple and descriptive type of map data visualization for election data are choropleth map and tile grid map. This is because the election data concerns about the sensitivity of geographic and values of the data. Choropleth map concerns about the geographical sensitive data but not the actual value of the data. However, tile grid map concerns about the value sensitive data but not the geographical data.

From the reviews of election visualization techniques, this study is more suitable to implement the tile grid map because there are 222 parliaments in Malaysia, which each tile can represent different parliament seat. The tile grid map can represents fixed size of tiles and helps the viewer to interpret the map easier as the number of the parliaments is fixed. The study uses a combination of map and bar chart to show the multiple points of views to the viewer using the election data.

3   Hexagon Tile Grid Map Representation

After the reviews, the hexagon tile grid visualization technique is chosen for visualizing the Malaysia election data because the hexagon shape offers more flexible arrangement of the tiles and able to maintain the border of the geographic map. This study uses a combination of HTML, Cascading Stylesheet (CSS), Javascript (JS) and Data Driven Document (D3.js) together with D3.js hexagon plugin - hexbin. The HTML and CSS were used to setup the foundation of the User Interface (UI) of the system while JS and D3.js were used to implement the algorithm flow of the system such as creating and populating the hexagon based on the coordinate data stored in JSON file. The hexbin plugin of D3.js is used to create the hexagon tile for a better coordination. All the outputs in the HTML document is in Simple Vector Graphic (SVG) format produced by D3.js.

3.1   Prepare the Data

The first step in this study is to prepare the data. There are four main data files, which are namely "setting.json", "parliament.json", "election.json" and "demography.json". Data in "setting.json" file includes settings for the SVG elements, settings for hexagon (which is the hexagon radius), the settings for tooltip functionality and lists of colors used in the system including political party color and colors for each state. Most of these settings are used to create the system user interface.

Data in "parliament.json" file include settings for each hexagon that represents each parliament by states. The data includes the state name list of parliaments in the state. For each parliament, it consists of the parliament code, name and the coordinate of the hexagon. The parliament code represents the code that will be used as a key to find the election data related to the parliament in "election.json" file. The hexagon coordinate is x and y coordinates that populate a hexagon that is related to the particular parliament.

Data in "election.json" consists of the actual election data that related to the parliaments. The data include a list of states names and election result for the parliaments. Each result consists of the parliament code, total voters, votes for each political party and the information about the winning party and candidate.

Data in "demographic.json" consists of the demographic information for both state and its parliaments. The demographic data for the states consist of the gender distribution in the state. Besides, it contains the ethnic or race distribution in that parliament. These external files are then called using d3.json() function.

3.2   Plot Hexagon Tile Grid Map

This study implements the pointy-top hexagon and the offset coordinate system that uses the classical 2-dimensional coordinate, x-axis and y-axis. Hexbin plugin is used to implement this offset coordinate system and requires a list of coordinates for the hexagon. From the coordinates, hexbin will create a hexagon path and place the hexagon on the specified coordinates. Furthermore, hexbin will also automatically place a partially overlapping hexagon side by side. Therefore, there will be no partially overlapped hexagon in the visualization. The process of populating the hexagon is retrieving the parliament coordinate data from the "parliament.json". The width and height of the SVG element are initialized based on the setting value retrieved from "setting.json" data file. The hexbin variable initializes the hexbin plugin by setting up the hexagon radius value that retrieved from "setting.json" data file.

3.3   Set State and Tile Color

For each hexagon tile in the map, it is colored to differentiate the states in Malaysia. The initial color codes are stored in the "setting.json" file. However, when the user clicks on the state, it will cause the selected state to change the color of each hexagon to certain color in order to differentiate the wining party of the parliaments in the state. In this study, there are four different colors to differentiate the main political parties in Malaysia. For instance, light blue represents The Alliance of Hope (Pakatan Harapan/PH), dark blue represents The National Front (Barisan Nasional/BN), green represents Malaysian Islamic Party (Parti Islam Se-Malaysia/PAS), and grey color for other parties.

3.4   Set State Labels

Then it follows by setting up all the state labels with names. The labeling process is implemented after all the hexagon tiles are plotted into the map. The text in the label is

based on the state label, which is stored in "parliament.json". The initialization of label style such as the font-weight, text-shadow, fill-text, cursor and pointer-event are set.

3.5 Set Event Listeners

The following step is to complete the event listeners for this visualization. The "mouse over" event will be triggered when the viewer hover the pointer over the hexagon tile. Then a tooltip will pop up to show the parliament code and parliament name. The next step is to create "on click" event listener. The event listener for the first level allows the viewer to click on the state, and then a popup board is displayed showing the demography of that state. The demographic information in this level contains the total population of the state and gender distribution. Then it sets up for the transition of zooming of the map so that it focuses on the selected state only. The zoom container is initialized that allows the zoom mechanic of the system.

For the "on click" event listener in the second level, two pie charts that contain election result and ethnic distribution will be displayed in the same popup board. The election result shows the total votes and candidates' names. The ethnic distribution shows the main races in Malaysia, which are Malay, Chinese, Indian, Sabahan, Sarawakian, and others. Finally, the Jason file is integrated in D3.js. It is needed to visualize the hexagon tile grid diagram. The d3.json function is used to load a file and returns its contents as Jason data object.

4   Results and Discussion

This study has created map visualization for Malaysia 2018 Election. Figure 5 shows Malaysia map in hexagonal coordinated format. Each state is labeled by its name and different color. The states are a group of hexagons that represents the parliaments.

Fig. 5. Malaysia 2018 election visualization. (Color figure online)

The map also can be toggled from the state view to the parliament view. Thus, the viewer can click on the hexagon tile, a pie chart will show the involved parties and political candidates together with the party that they represent and the number of votes

won by that candidate in that particular parliament. Besides, the hexagon will change its color to the winning party. Moreover, when the viewer hovers over the hexagon tile, the visual will pop up the parliament code and name. A bar chart is used to communicate the most basic things of the election data, which is the ethnic distribution for each parliament as displayed in Fig. 6.
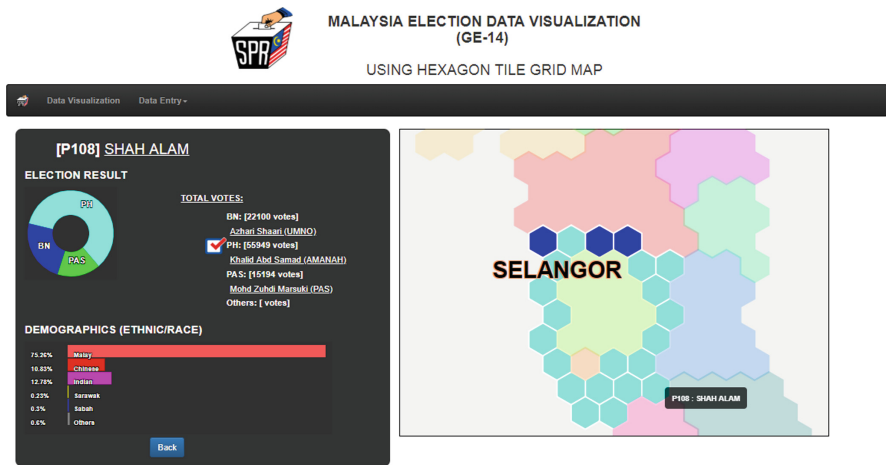

Fig. 6. Election result and ethnic distribution. (Color figure online)

This simple color map visualization presents more granular data to reflect the results of Malaysia 2018 General Election. It eases the exploration and interpretation of election data by providing a quick overview of winning parties in the particular state, the winning candidates, distribution of votes, and distribution of ethnic. It helps the associated agencies indirectly to analyze the voting pattern based on the demographic distribution.

5   Conclusion

This study has applied the data visualization technique to help visualize Malaysia 2018 General Election. The hexagon tile grid map visualization technique shows the potential to be used to represent election data as shown in many countries. It helps to promote creative data exploration by significantly reflecting the voting pattern between the political parties, its candidates, total votes, and ethnic distribution. The hexagon tile grid map visualization helps Malaysian to view the election result more interactively. The map can be toggled from the state view to the parliament view. Thus, the viewer can click on the hexagon tile to view the political parties, its candidates together with the number of votes won by that candidate in that particular parliament. Therefore, with the help of visuals, the viewer can interpret easily the election result in Malaysia.

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