Data Vizualization for Computer Inventory

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ABSTRACT

Data visualization is a discipline of the visual representation of data to convey the information clearly and efficiently. Based on our study, the computer inventory data of Universiti Teknologi MARA, Shah Alam, Selangor is still reported using spreadsheets. Thus, it is difficult task for this organization to analyze, observe and understand, especially when the data are scattered in several location without using the data visualization approach. In this paper, we proposed the map-with-latitude-longitude technique to visualize the computer inventory which located in several places. The main idea of the proposed method is to visualize the distribution of data using map so that will provide the information in visual form for all the stakeholder e.g. information officer and manager to make any related decision in future. The result shows that the map-with-latitude-longitude technique works well and presents the information of computer inventory clearly.

Keywords: Data visualization, leaflet, Openstreemap, D3.js, map-with-latitude-longitude.

I INTRODUCTION

Data visualization is a way to express the data in visual form that can help us to find the blind spots. We might miss something, if we just look at the bare of the original data. The data visualization help us to acquire the knowledge from seeing the objects (Fu et al., 2013). The data visualization can be defined as an information which has been abstracted in some structure form, including attributes or variables for the units of information (Friendly, 2009). In addition, data visualization has the ability to explains its importance by displaying the data in terms of visual context. It also can be observed from different viewpoints and used more detailed observation and analysis.

One of the advantages of using charts or graphs to visualize large amounts of complex data is ease for human brain to process information rather than poring over spreadsheets or reports. It is a fast and easy way to convey concepts in a universal manner by using data visualization and anyone can experiment with different circumstances by making minor adjustments (Sankaranarayanan, Agarwal, & Rathod, 2016).

The Universiti Teknologi MARA (UiTM), Shah Alam, Selangor has been chosen as our scope of study specifically for the computer inventory. UiTM is the public university in Malaysia that is based primarily in Shah Alam, Selangor. The university now has 35 campuses, comprising of one main campus, 13 state campuses and 21 satellite campuses. With its large infrastructure, UiTM have a number of faculties and academies, with 27 faculties including two academies and one graduate school. 508 programmes offered by UiTM consisting of PhD, master, bachelor, diploma and certificate levels (Malik, 2017). Since UiTM is a large institute, the data that needs to be stored by them, are also large. When there are many data that needs to be stored, it becomes a big data. Big data is a term for data sets that are large. When it is large, it is complex for traditional data processing software to deal with. Problems might arise comprise to capture, storage, analysis, data curation, search, sharing, transfer, visualization, querying, updating and information privacy (Shah, Soriano, & Coutroubis, 2017).

II RELATED WORK

The data visualization can be divided by off-line and on-line environment approach (Lee, Jo, & Kim, 2014). The off-line environment approach has been used for long time ago for example Matlab, Mathematica and Godiva. In off-line approach, all the data and visualization software reside in one machine which also can called as standalone processing. While, the on-line approach, which the current trend nowadays, using the web based data visualization due to the popularity of web interface.

There are several different types of web-based visualization tool such as Google Charts (Zhu, 2012), Adobe Flex (Juszkiewicz, Sakowicz, Mazur, & Napieralski, 2011), OFC ("Open Flash Chart (OFC)," 2018) and Data Driven Document (D3.js) ("Data-Driven Document (D3.js)," 2018). In this research, the D3.js is selected because it is freely available under Berkeley Software Distribution (BSD) license. It supports several data type such as

Java Script Object Notation (JSON), eXtensible Markup Language (XML) and comma-separated values (CSV). D3.js uses Scalable-Vector-Graphics image (SVG), HTML5 and Cascading Style Sheets (CSS) for graphical representation. The most significance criteria of this tools for this research, it supports advanced visualization algorithms such as geography and geometry. It has various functions to assist visualization especially manipulating associative arrays and map.

In D3.js there are several techniques that can be used to visualize data. Rodden (2014), proposed to summarize the user navigation sequences for website using sunburst technique. It is a useful way to represent proportion by using the radial space-filling approach for those user who are familiar with pie and donut charts. This compact representation can fits simply onto a single screen for instant understanding. Praveen et al. (2017) used box plot and control chart to analyze the data for air quality. One of the advantage of using this technique is it is easily to make a relations between samples and can find the outliers. Chankhihort et al. (2016) used calendar view for car manufacturing process domain. This approach offers the interactivity to the process manager whereby the manager can click to any square shape to see the details of the manufacturing process for any day. It also gives the flexibility to the end user to control and manage the entire manufacturing process. Carvalho et al. (2016) used a treemap for temporal data visualization that combines the aspect of treemap and calendar. The main aims of temporal treemap is to allow exploration of time dimension as primary attribute without information workload. This technique can be used to analyze temporal databases of different granularity.

Different techniques of D3.js can be applied based on the particular scenario and domain. Therefore, the map-with-latitude-longitude visualization technique is chosen since it suitable with the objective of this research, to visualize the distribution computer inventory data.

III METHODOLOGY

Figure 1 illustrates the workflow of data visualization process. The first step of this study is to acquire the data. The computer inventory raw data were obtained from Infostruktur Department, UiTM that provide all the Information and Communication Technology (ICT) services in UiTM. There are 59 responsibilty centre e.g. faculty, institute, academy, office, center, program and unit which can be divided to four categories. The categories are administration, academician, computer lab and class.
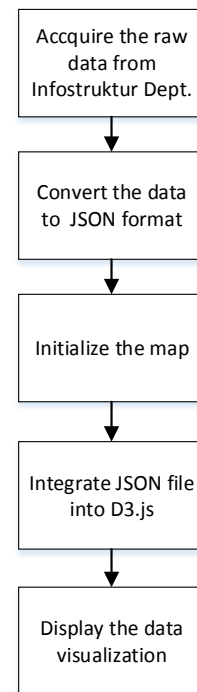

Figure 1. Workflow Of Data Visualization Process

The second step, from the collected raw data, it then converted into JavaScript Object Notation (JSON) format as shown in Figure 2. JSON is an open-standard file format that can be used to transmit data object including of attribute-value and array data types using human-readable text. ("JSON," 2018). There are two properties that need to be stored. First is the data that needs to be displayed and secondly, the coordinates of each responsibility centre.

Figure 2. Data Stored in JSON File

```
var faculty = {
  "type": "FeatureCollection",
  "features": [
    {
      "type": "Feature",
      "properties": {
        "marker-symbol": "",
        "marker-color": "#7e7e7e",
        "marker-size": "medium",
        "name": "FSKM",
        "administration": 200,
        "academician": 1,
        "computerLab": 292,
        "class": 142
      },
      "geometry": {
        "type": "Point",
        "coordinates": [
          101.50015890598297,
          3.0713257054423186] }},
```

Figure 2 shows an example GeoJSON format. GeoJSON is a JSON format that designed for representing simple geographical features ("GeoJSON," 2018). The segment "type:Feature" is the type declaration of GeoJSON object which is called 'feature object'. A 'feature object' must consist of 'geometry' member and a 'properties' member. The "geometry: {}" segment is used to save the location consists of longitude and latitude. While the "type":"Point" segment is a segment to declare geometry object type 'point'. The object coordinates must be a position for the type of 'point' (Gunawan, Ferdinandus, & Setiawan, 2017).

The third step is to initialize the map and set the centre of the map where it should be. First, we need to find an online map tiles that can be used. We even can use the maps provided by Google Maps. However, OpenStreetMap ("OpenStreetMap," 2018) was selected, since it is free access with open-content license map and belong to large volunteer community. In order to setting up the map, we need to include Leaflet CSS and Leaflet js together where it can be imported directly from online library or it can be downloaded first to use as offline. Leaflet is an open source JavaScript library that can be used to build web mapping applications ("Leaflet," 2018). Next, we need to declare an appropriate variables and add the tile layer to the map. Creating a map tile usually involves the setting of Uniform Resource Locator (URL) template for the map tile images, attribution text and the maximum zoom level of the layer. Figure 3 shows the variable called 'map' that is created and the centre of the map has been set at the coordinate of UiTM, Shah Alam, Selangor, Malaysia with current zoom at 16. The URL template is set with the link of the OpenStreetMap template.

```
var map = L.map('map').setView([3.0698,101.4994], 16);
    mapLink =                              '<a href="http://openstreetmap.org">OpenStreetMap</a>';
    L.tileLayer(
'http://{s}.tile.openstreetmap.org/{z}/{x}/{y}.png', {
    attribution: '&copy; ' + mapLink + ' Contributors', maxZoom: 100,
    }).addTo(map);
```

Figure 3: JavaScript Code to Read from JSON File

```
var values = feature.properties;
        var data = [

{name:"Pentadbiran",value:values["administration"]},
{name:"Staf Akademik",value:values["academician"]},
{name:"Makmal Komputer",value:values["lab"]},
{name:"Kuliah",value:values["class"]}
];
```

Figure 4. Four attributes to visualize bar chart

Once the data have been converted to JSON and the map has been initialized, the fourth step is to integrate JSON function and D3.js function into the map.

Figure 4 shows the JavaScript code to read from the JSON file and it will put in an array of data. These four input values will be used to visualize the bar chart.

```
var x = d3.scale.linear()
        .domain([0, d3.max(data, function(d){return d.value;})])
        .range([0, width]);
var xAxis = d3.svg.axis()
        .scale(x)
        .orient("bottom");
```

Figure 5. Function To Create Scale Of Bar Chart

Figure 5 shows the function d3.scale.linear to create the continuous scale with the unit domain and range, while the function d3.svg.axis displays the reference lines for scales automatically.

IV RESULTS

The functions and algorithms that have been discussed will resulted as illustrated in Figure 6. All the markers are set at each responsibility centre around UiTM.

Figure 6. Overall View Of Uitm With Markers

Figure 7 illustrates that the bar chart of computer inventory will be displayed in the popup window when user click on it.
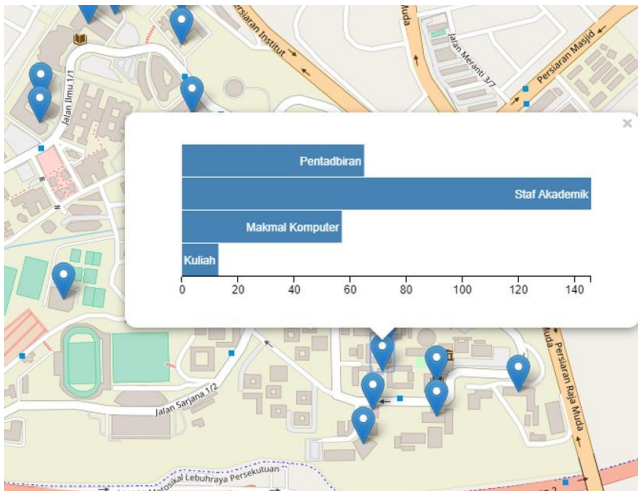
Figure 7. Displayed Bar Chart

V CONCLUSION

This paper presented the development of data visualization for computer inventory using map-with-latitude-longitude approach. This approach is able to visualize the scattered computer inventory location in several location in UiTM. The stakeholder e.g. information officer or manager can easily obtained the information in the chart form regarding the number of computer inventory which divided to four category such as administration, academician, lab and class. This study can be further improved by adding previous year data so that the stakeholder can compare the different number of computer inventory every year with the current year.

ACKNOWLEDGEMENT

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