Data visualization for distribution of people with disabilities

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Abstract. Data visualizations make data easier for the human brain to understand, and visualization also makes it easier to detect patterns, trends, and styles in groups of data. With the development of the data visualization, more and more data which contains the information of disabled population has been collected. However, researchers have pointed out some problems with visualizing data especially using traditional methods. Therefore, this study aimed to develop a web-based system for data visualization of disabled people distribution in Kuala Selangor, Selangor, Malaysia. Prototyping methodology was chosen in order to develop the web-based system. The results show two main interfaces of the web system which are the admin module and user module. Users may see a specific area, type of disabled people categories and the number of disabled people in the located area from the Google Map. This web system is hope to help public in identifying disabled people location using data visualization technique. In addition, in future it could help the authorize institutions/ bodies in doing better planning for disabled people education, facilities and other needs based on its location distribution.

1. Introduction

One billion people, or 15 percent of the world’s population, experience some form of disability, and for developing countries, the rate of disability is higher. One fifth of the world’s estimated total, or between 110 million and 190 million people, has severe disabilities [1]. Persons with Disabilities Act 2008 defined persons with disabilities as those with long-term physical, mental, intellectual or sensory disabilities that may hinder their full and effective participation in society in interaction with different barriers. According to [2], there are 453,258 people in Malaysia with various category of disabilities registered in year 2017. People with disability defined as Persons With Disabilities (PWD) can be categorized as visually impaired, hearing, physical, learning disability, speech, mental and multiple disabilities in Malaysia. In today’s digital world, all data’s are necessary to be digitized. With the development of the web based technology and storage techniques, datasets which contains the information of disabled population has been collected by the responsible body/institutions [3]. Through analyzing these precious disability datasets, people can gain knowledge pertaining the living conditions, location and demands of this disabled population [4]. Therefore, the objective of this study is to collect and manage datasets of the disabled people which are gathered from Department of Social Welfare
(DSW), Selangor, Malaysia and later manage the data by using data visualization through web-based system. The purpose of managing the datasets is to ensure the information is available for public so that current status of disabled people, specific area that can show types of disabled people and the number of disabled people is updated and available online.

2. Related Works
As to date, there are several related research focusing on the disabled people datasets using current technology researching on data visualization [5], data management and big data analytics [3], locating or identifying facilities with using GPS technology [6] and many more. For instance, the data management using data mining and big data approach on disability datasets can enable data-driven decision-making for professionals who work with disabled populations [3]. By analyzing the datasets either individuals, professionals or researchers who work with disabled populations can have a better understanding on the future plan or policies for this disabled populations. However, there are several issues raised by scholars [7], [8] regarding managing and analysing the disability datasets with traditional methods such as the data qualities involving missing values, accuracy, data authenticity and disability data attributes which are correlated and interactional with each other.

Other study by [6] focusing on the searching of disabled people information in visualization view. Google Map is used to provide information about disabled types of people such as blind, deaf and physical movement. In addition, the study also provides specialized data for company and government officers for managing and planning local facilities for disabled people in the cities. All the related works that have been discussed earlier proves that there are efforts from scholars to help presenting disability datasets for public using various technology and the effort is still continuously evolved. In fact, there are still a lot more work to do since there are still unanswered questions on how many disabled people in any area or what is the current amount of specific people with specific disabilities in certain location.

3. Methods
In this section, we described the process from how the data on disable people were gathered and then the process of cleaning the data. Next, we described the system development processes complemented with appropriate diagram to present the output for better understanding. In this study, we firstly determined the case study of this research which is Kuala Selangor. Kuala Selangor is one from a total of nine districts in Selangor State, Malaysia. This municipality was chosen as the study area because it is among largest district in Selangor and has about 205,207 total populations [9].

3.1. Data Collection and Data Cleaning
In Malaysia, The Ministry of Women, Family and Community Development (KPWKM) was given the trust and responsibility in resolving issues and problems relating to target groups, especially children, the disabled, senior citizens, the destitute, non-governmental organizations (NGOs) and disaster victims since April 2004. Department of Social Welfare is one of the department under KPWKM that focuses on solving the issues and problems pertaining disabled people. Therefore, in order to gather data on disabled people in Kuala Selangor district, series of appointment has been made with DSW.

An interview session with the respected officer from DSW were conducted and we managed to gather in total of 3489 disabled people data in Kuala Selangor for year 2018. Data obtained was in Microsoft Excel format with tabulated data containing Date, File Number, Name, Address, IC Number, Gender, Age, Ethnic, Disability Category and Registration Number. For disability category there are altogether 4 types which are learning, speaking, hearing and physical. Since the data gathered were in various written format, some need modification and therefore, cleaning process is necessary. The process of cleaning the Ms. Excel were done manually using formula to remove such as extra spaces and blank space, duplicates data, converting numbers stored as text into numbers and change text to lower/upper/proper case. Final data were then saved in Ms. Excel back to be imported in web system database.
3.2. System Development

The prototyping model was chosen in this study. The processes start from design, test and rework as required until a satisfactory outcome is obtained from which the full system can later be developed. The client can get a real sense of the system by using this prototype, because the interactions with the prototype will help the client to better understand the specifications of the desired system.

- Requirements

User requirements also referred as user needs, define what the user does with the program such as the tasks that users have to be able to carry out. In this study, a set of questionnaire were created using Google Docs which is an online medium used to obtain feedback and reviews from respondents on their knowledge and interest based on the web system they required. The following Table 1 depicted total number and percentage of respondent’s details. Total number of respondents selected is 26 consists of 10 males and 16 female respondents. Age of the respondents is from 13 to 21 years old or 22 years old and above.

| No. | Respondents Information | Age Categories |
|-----|-------------------------|----------------|
|     | Gender | Total | Percentage (%) | 13 - 21 | >22  |
| 1   | Male   | 10    | 38.5            | 14      | 12   |
| 2   | Female | 16    | 61.5            |         |      |

For this user requirement phase, user was asked on their preferences of web system features and interfaces for repository of disabled people data. Other than that, questions related to general knowledge on disabled people information were also asked. Respondents has given their own opinion about why it is important to have web-based system for visualizing data about disabled people. Those are among the answer that have been given by respondent:

i. Because it is important
ii. Because disabled people need extra attention
iii. Because sometime this kind of website could help someone
iv. Easier for user to access information
v. Data is accessible to all
vi. It can store many information of a certain people such as personal information, medical records, retrace the caretaker.
vii. For citizen to aware of the existence of disabled people.
viii. To have awareness of disabled people
ix. For research
x. For general knowledge

- Quick Design
A preliminary design or quick design for the web system was created when requirements are known. It is not a detailed design, and includes only the system’s important aspects, which gives the user an idea of the system. A quick design will later help in prototype development. Figure 1 shows use case diagram of the web system. The use case diagram shows a list of actions or event steps typically defining the interactions between a role. There are two actors in the system which are the admin and the user. Admin basically can log in and log out from the system, register for system accessibility, manage for data entry, manage setting and generate several types of analysis. Meanwhile, the users are allowed to manage settings and generate analysis only.

- **Build Prototype**
  Information gathered from quick design is changed to form the first prototype which represents the necessary system’s working model. Development tools that are used to develop the web system are PHP, HTML, Javascript and MySQLi.
- **User Evaluation**
  Next, for a thorough evaluation of the prototype, the proposed system is presented to the user to recognize its strengths and weaknesses, such as what is to be added or removed.
- **Refining Prototype**
  Once the user evaluates the prototype, and the current prototype is refined according to the requirements if it is not satisfied. That is, a new prototype is being developed with the user's supplementary information. The new prototype is assessed as is the previous prototype. This process...
continues until all user-specified requirements are met. Once the consumer is pleased with the initial prototype, a final design based on the final prototype is produced.

- Implement and Maintain
  On fulfilment of the specifications the customer accepts the final prototype. The final system is carefully tested, preceded on a regular basis by routine maintenance to prevent large-scale failures and reduce downtimes.

4. Results and Discussion
Findings of this study are divided into two parts, which are the admin module and user module.

4.1. Admin Module

![Figure 2. Dashboard of Admin Module](image)

In this module, admin is required to enter their username and password before they can get access into the web system. A message box displayed “Data is not registered” will appear during the login for any unauthorized admin. As for admin, they are allowed to browse through some information that has been provided on dashboard page such as total amount of disabled people, total of disabled people by categories, total disabled people race and total disabled people area’s in Kuala Selangor as depicted in Figure 2.

![Figure 3. Map Distribution of Disabled People in Kuala Selangor](image)

The map as shown in Figure 3 is interactive which the user may can interact with the embedded map
by clicking on the icon and the details of the disabled people will be displayed according to its location. The displayed data is quite rich with information, it will generate the location name, total number of disabled people in that location, total number based on gender distribution and types of disabilities. Besides that, there is also analysis web page where admin can see the analysis of disabled people based of four options which are gender, category, race and area as depicted in Figure 4.

![Analysis Web Page View for Admin](image1.png)

**Figure 4.** Analysis Web Page View for Admin

In gender, category and area pages, user is provided with summary charts and OKU details that has been divided according to their categories. Admin details will be displayed and admin can update or delete the details. Besides, this module was equipped with admin button that was linked to admin registration form web page. Admin details will be displayed and admin can update or delete the details.

4.2. User Module

In this module, user may get some information that has been provided such as total amount of disable people, total disable category, total race and total area in Kuala Selangor same like the dashboard view for admin. User might as well interact with the map that has been embedded to the website which user can click on icon and the details will be displayed according to disabled people’s location. In addition, users are also provided with some knowledge about PWD.
Figure 6. Analysis Web Page View for Disabled People Area

The above Figure 6 shows the interface of analysis for each area that contains disabled people. User can obtain information on disabled people for each dedicated area either in summary or in detail.

5. Conclusions
In this paper, we presented a web-based system for data visualization of disabled people distribution through map. The web-based system can help people in getting visualized data for total number of PWD surrounding Kuala Selangor area and then explore useful information from it. The distribution of PWD can be seen through four categories which are by gender, categories of disability, area and races. As for future work, this study can be extended by carry out data analytics to predict the accessibility of rehabilitation and education centres around the area which have high number of PWD population. It is good to investigate whether the existing rehabilitation and education centres number in Kuala Selangor is sufficient to accommodate PWD in this area. Perhaps, the system/application could provide the route to the nearest rehabilitation and education centres.

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