**CHAPTER 3**

**METHODOLOGY**

This chapter explains about the methodology that were being implemented for he development process. The project implements the waterfall model which is the classic model of software engineering (Munassar, N., M., A. & Govardhan, A., 2010). This chapter will explain about what waterfall model is, the phases involved, the processes and activities that were done during the each of the phases and the deliverables that will be produced for each of the phases.

**3.1 Waterfall Model**

Waterfall model is the first and the oldest model that was being introduced as part of the Software Development Life Cycle (SDLC) approach that was used in software development (Munassar, 2010; Sharma, 2016). It is one of the simplest and easiest to understand SDLC (Sharma, 2016). It emphasizes planning before development to ensure the detection of possible flaw before the system are being built and this model works well for a quality concerned project. Figure 3.1 shows the phases of SDLC involved in waterfall model.

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| SDLC Waterfall Model  **Figure 3.1** General overview of waterfall model  (*Source:* TutorialsPoint, 2017) |

Waterfall models are divided into multiple phases and progress of the phases were flowing downwards like a waterfall (Sharma, 2016). Each phase in the waterfall model begins only if the previous phase has been completed and the previous phase’s output act as the input for the next phase (Sharma, 2016).

The phases that this project will be following is based in Figure 3.1, which is Requirement Analysis, System Design, Implementation, Testing and Deployment. Maintenance phase will not be executed during the development of this project because the objective of this project is up until deployment only.

* + 1. **Requirements Analysis**

The objective of requirement analysis phase is to analyze and understand the requirement for the system and produce the specification for that system (Sharma, 2016).

The activities that were being done during this phase was determining the problem of current Malaysia election data visualization, determine the similar system that has been implemented by other countries such as United States (US), United Kingdom (UK), Australia and India and come out with a solution to solve the problems of Malaysia election data visualization. The problem of current Malaysia election is most of it were presented in tabular format, simple graphs or charts, were not interactive and the data visualization output cannot dynamically change according to inputs. Based on the observation of the data visualization for the selected countries, this project is determined to produce a solution that can solve Malaysia election data visualization by hexagon tiled grid maps as explained in Chapter 2.

The deliverables for this phase is the completion of the first objective as stated in Chapter 1, which is to identify the suitable data visualization technique for Malaysia election data. The suitable data visualization techniques that were explained in Chapter 2 is hexagon tile grid map with the approach of interactivity and dynamic ability of the map, presenting a basic representation first before presenting a more complex representation and presenting a combination of multiple charts other than the map. Figure 3.2 shows the objectives, activities and deliverables that were produced during this phase.

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| **Figure 3.2** Objectives, activities and deliverables for Requirement phase. |

From the result of this project’s objective 1, a set of requirements were determined as a guideline for the next phase System Design. The requirements were determined and presented in a form of use case as a better medium of communication between software engineers. Use case diagram is a Unified Modelling Language (UML) notation as a tool to communicate the idea of a software development requirement (Bhattacharya & Sengupta, 2009) and for this project, it was used a way to visualize and communicate the requirement. Figure 3.3 shows the use case diagram for this project.

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| **Figure 3.3** Use Case diagram for the requirement of the project. |

Based on Figure 3.3 a use case description has been documented to explain the process of each of the use cases for a better understanding during the System Design phase. Table 3.1 shows the documented use case descriptions.

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| **Table 3.1** Use case description   |  |  | | --- | --- | | **Use Case Name** | Data Visualization | | **Actor** | viewer | | **Pre-Condition** | Viewer open the data visualization system | | **Post-Condition** | - | | **Main Flow** | |  | | --- | | **system** | | 1. Load parliament, demography and parliament data from data file. | | 1. Initialize retrieved data for Election Data Visualization and Demographic Data Visualization. | | 1. Visualize the data based on Election Data Visualization and Demography Data Visualization use cases. | | | **Alternative Flow** | Election Data Visualization:   1. Initialize the size, color, location and event listener for each hexagon tiles. 2. Populate the hexagon tiles to produce hexagon tiled grid map. 3. Populate the election data visualization when the initialized event listeners were triggered.   Demography Data Visualization:   1. Initialize the data for gender and ethnic data visualization. 2. Visualize the data in a form of pie chart and bar chart. | |
| |  |  | | --- | --- | | **Use Case Name** | Data Entry | | **Actor** | admin | | **Pre-Condition** | Admin visit the data entry system | | **Post-Condition** | - | | **Main Flow** | |  |  | | --- | --- | | **admin** | **system** | |  | 1. Load all data from data file and fill it into data entry form. | | 1. Admin enter data into the form and submit. |  | |  | 1. System saves all data into data file. | | | **Alternative Flow** | - | |

**3.1.2 System Design**

The objective of System Design phase is to study each of the requirements stated in the Requirement Analysis phase and produce a system design for the expected system (Sharma, 2016).

The activities that were done during this phase is designing the system flow, determine the technology that will be used for the development of the system and designing the User Interface (UI) of the system.

The deliverables produced during this phase is the system flowchart to show the complete flow of the system both for viewers and administration, the determination of technologies that this project uses and the user interface (UI) mockups for this system. The technology that were used for the development of this system are Hypertext Markup Language (HTML), Cascading Stylesheet (CSS), Scalable Vector Graphic (SVG), JavaScript, Data Driven Document (D3.js) which is a JavaScript library used to manipulate document based on data and JavaScript Object Notation (JSON) which is a lightweight data-interchange format to store the parliament, demography and election data. Figure 3.4 shows the stated objectives, activities and deliverables that were produced during this phase. Figure 3.5 shows the overall system flow, Figure 3.6 shows the UI mockups.

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| **Figure 3.4** Objectives, activities and deliverables for System Design phase. |

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| **Figure 3.5** Malaysia Election Data Visualization system flow. |

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| **Figure 3.6** Data entry system flow |

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| **Figure 3.6** UI mockups. |

**3.1.3 Implementation**

The objective of the Implementation phase is to develop the designed system as stated in System Design phase.

The activity of this phase is to implement part of the system in small unit first before integrating all the units to form a full system (Sharma, 2016). The development of the system includes the process of single hexagon tile setup, JSON data file setup, hexagon tiled grid map plotting, hexagon tile color setup, state labelling setup, event listener setup and data entry system setup. The development process of the system is explained in Chapter 4.

The deliverables of this phase were the completion of the second objectives of this project as stated in Chapter 1, to develop the system on the chosen data visualization technique. The system should implement all the functionalities as designed in the Design phase. Figure 3.6 shows the stated objectives, activities and deliverables that were produced during this phase.

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| **Figure 3.6** Objectives, activities and deliverables for System Design phase. |

**3.1.4 Testing**

The objective of this phase is to validate the developed system so that it meets the required functionality as designed in Design phase and as stated in Requirement Analysis phase.

The activities of this phase were to do a validation for the accuracy of the system output based on the given input. The validation process is done by comparing the output of the system with the given input and if the input data is visualized correctly or in a correct location in the map, it is considered accurate. The result of the evaluation is tabled in Chapter 5.

The deliverables of this phase were the completion of the third objective of this system as stated in Chapter 1, to validate the accuracy of the visual with the actual data. Figure 3.7 shows the stated objectives, activities and deliverables that will be produced during this phase.

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| **Figure 3.7** Objectives, activities and deliverables for System Design phase. |

**3.2 Summary**

This chapter explains about what method that were being implemented to develop this project and each of the phases in the methods were explained in detail. This project implements the Waterfall Model. Waterfall Model is the basic Software Development Life Cycle (SDLC). The phases in this model is Requirement Analysis, System Design, Implementation, Testing, Deployment and Maintenance. However, this project will not be going to implement the Deployment and Maintenance phase the objective of this project is up until to validate the accuracy of the output with the actual election data. The output of the Requirement Analysis phase was explained in Chapter 1 and Chapter 3, the output of the System Design was explained in Chapter 3, the output of Implementation is explained in Chapter 4 and the output of Testing and Deployment are explained in Chapter 5.