

Application of Graph Theory in Website Structure

Muhammad Rafid Amrullah / 13515125
Program Studi Teknik Informatika
Sekolah Teknik Elektro dan Informatika
Institut Teknologi Bandung, Jl. Ganesha 10 Bandung 40132, Indonesia
13515125@std.stei.itb.ac.id

Abstract— Webiste or World Wide Web also known as Web is one of the most important things in the digital era. Web is commonly used for several field such as market, education, and online games. Behind the frequently use of web, it has a website structure that construct the whole of the web. This paper will explain how graph is useful to design and construct a website structure. Some example included for deeper understanding a use of graph in website structure.

Keywords— graph, website, web design, website structure.

I. INTRODUCTION

World Wide Web or WWW is the graphical interface for the internet that was invented by Tim Berners-Lee when he worked at CERN, the particle physics laboratory. World Wide Web or Web can be accessed from browser (Firefox, Opera, Chrome, Safari, Microsoft Edge) and usually automatically visit the Home Page as the first entrance of the website. From the Home page, visitor can reach other page.[1]

The pages in the website is called web page. The whole website on the internet have a standard technologies that developed by World Wide Web Consortium or W3C. HTML, CSS, and SVG are several technologies that provided by W3C.[2]

Web page is essential part in the every website. The web page construct a website and can be linked each other to access whole available menus. Web page that linked to other page will form a website structure.

In this paper the definition of website structure is a group of web page that linked each other. Usually the starting point of this structure is called Home Page. This page usually contain an overview about those website.

To Build a big and complex website it will bring out the problem about website structure management. In this case the website required a tools to manage the website structure. This paper will explain which tools is great to solve the problem.

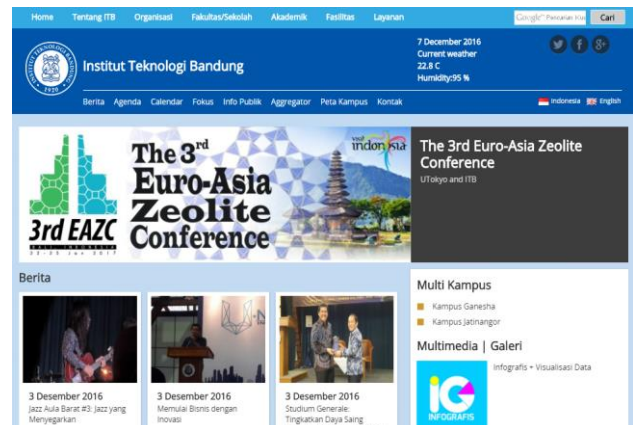


Figure 1.1 ITB Home Page
<https://www.itb.ac.id/>
Accessed on 7 December 2016

II. BASIC THEORIES

A. GRAPH DEFINITION

In mathematics graph is defined as the structure that made up by vertices or nodes which is connected with edges or arcs. Assume we have G as a graph, we can write $G = (V, E)$. In this case V is a nonempty set of vertices (nodes) and E is a set of edges (arcs).[4]

This is an example of simple graph

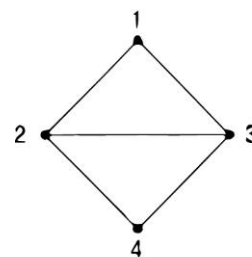


Figure 2.1 simple graph

B. GRAPH CLASSIFICATION

Graph classified depending on the presence of double edges and loops, number of vertices, and edges direction.

1. Presence of double edges and loops.

They are categorized upon three. First is simple graph, this graph does not have a double edges or loops. Second is multigraph, this graph contain double edges and no loops. Third is pseudograph,

it contain loops and may contain double edges.

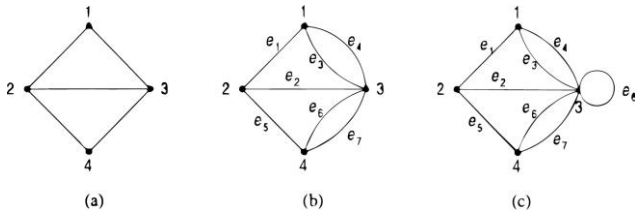


Figure 2.2

(a) simple graph, (b) multigraph, (c) pseudograph

2. Number of vertices.

Two category based upon number of vertices. First is finite graph, this graph has a finite number of vertices, otherwise the second is infinite graph, it has a infinite number of vertices.

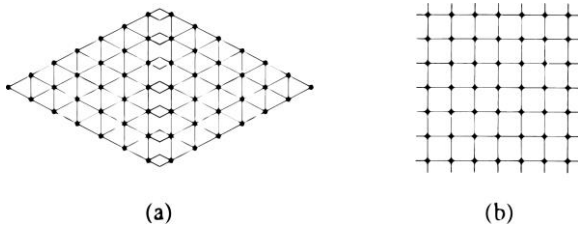


Figure 2.3 (a) finite graph, (b) infinite graph

3. Edges direction.

Graph have no direction at his edges is undirected graph. Otherwise, graph that has directions at each of his edges called directed graph.

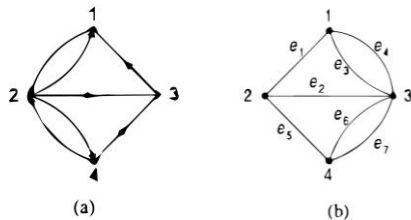


Figure 2.4 (a) directed graph, (b) undirected graph

Graph classification summarized in the table below.

Category	Edges	double edges	loops
Simple Graph	Undirected	No	No
Multigraph	Undirected	Yes	No
Pseudograph	Undirected	Yes	Yes
Directed Graph	Directed	No	Yes
Directed Double Graph	Directed	Yes	Yes

Table 2.1 Graph Classification

III. WEBSITE STRUCTURE

A. Website Classification

Website sturcture in general classified into three. This classification based upon the page design that construct the whole website.

1. Pure Single Page Website

The structure of this website is single paged website that mean a whole website is contain in one single page.

One page structure is a modern website sturcture. This website structure is popular in 2015 because of his simplicity and comfortability. User will keep focus to the content of the website while reading on this structure.

Innovation of this structure are various, the effect often added to improve website performace like hover, transition, scroll and motion effect. User provided to interact with a website with a rich interactive component of the website.

The important point about this website are:[5]

- Flawless, intuitive and to easy to understand the core of the website.
- Uses story to describe and telling about the website
- Profound and easy to bring emotional.
- Easier to update the design or content.
- One page, little data to download the overall website. The visitor of this website usually will spend a slight bandwidth to download the pages from their browser.
- Slow to load if the page is full of rich content, this website will be hard to download.
- Single page make this website easy to adapt with a various kind of devices (desktop, smartphone, tablet, etc).
- Not effective if implemented for a complex system such as market place, ecommerce, ebanking, or online course/training.
- Easy to manage the content.
- Cheaper than multi page. Usually a single page has a cheaper price than multi page.

Normally the website that use this structure not required many features and straightforward serve a singe product or service . As an example Curriculum Vitae Webiste, it does not require many features, so this website is great to implemented by one page structure.

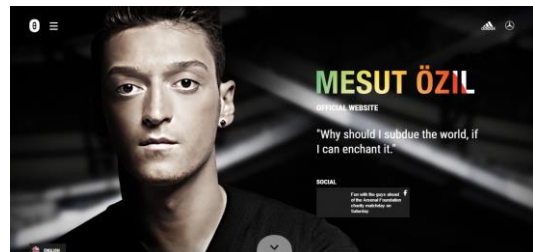


Figure 3.1

<http://www.mesutoezil.com/>
 Accessed on 9 December 2016

For Instance, Mesut Ozil Website with a single page structure. Brief explanation about Mesut Ozil. The visitor of this website are provided to keep focus about Mesut Ozil.

To build a complex system such as market place website using this structure is won't be effective. Many features will not be orderly and has a big problem about user experience.

2. Pure Multiple Page Website

This website come with a pure multiple web pages. This is a usual and traditional website stucture that spread on the internet. For a complex system such as electronic banking, market place, and ecommerce website, this structure is required because the system contain a multi features that must be separated each other. For example the market place website or ecommerce website required website profiles, storefronts room, payment system, transaction history, and many more that will be effective if united in a multiple page website.

The advantage of this structure are the great scope of the implementation. Website developer will be free to separate each features or part of the website.

The important point about this website are: [6]

- Large website because the multi pages.
- Broad scope to implement. Small website such as portofolio website until big company webiste are good to implement with this structure.
- The number of content will make the website must have a standard scheme.
- Multiple page, multiple entrance. The way to enter this website is many. User can choose a way to get information from this website.
- Better control of SEO.
- More page, bigger data to download. The visitor of this website usually will spend more bandwdith to download the pages from browser.
- Big effort to adapt with a various types of devices (desktop, smartphone, tablet, etc) due to the multiple pages, features and purpose.
- More expensive. This structure usally more expensive than single page website because the complexity.

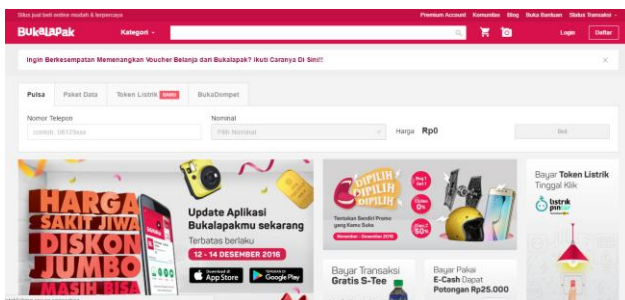


Figure 3.2

<https://www.bukalapak.com/>

Accessed on 9 December 2016

For Example, Bukalapak as market place, they are using multiple page structure.

3. AJAX Website

The structure of this website are nearly same with the multiple page structure and some time close with the single page structure.

The explanation about this structure begin with the definition about AJAX. AJAX stands for Asynchronus JavaScript and XML. This is a technique to create a faster, realiable and better website.

Several uses of AJAX:[7]

- Load and update part of web page without loading a whole page.
- Send data to a server (in the background, without known by user).
- Request data from a server (after the page has loaded).
- Receive data from a server (after the page has loaded).

Some important point about AJAX:[8]

- HyperText Markup Languge (HTML), Cascading Style Sheet (CSS), eXtensible Markup Language (XML), and Javascript language as the component.
- Uses CSS for presentation, eXtensible HyperText Markup Language (XHTML) for contents, along side Document Object Model and Javascript for interactive and dynamic contents.
- Deliver information to and from the server using synchronous requests.
- Usually XML used to receive data whatever the format even plain text.
- Independent with web server software.
- Worked in the background. User can not see what happen between AJAX and sever.
- User can work with website when AJAX working in the background.
- Natural user interaction. Website user does not required to learn any website developer skills.
- Data driven that opposite with page driven.

AJAX is a Rich Internet Application (RIA). This is the most rich so far for the internet application in 2016. The whole advanced internet industry in this world mostly using AJAX and some framework using AJAX too.

AJAX based on the several open standard such as browser based performance using HTML and CSS, data received from the server in XML format file, in the background data receive using XMLHttpRequest objects in the browser, and Javascript as the core and gear of AJAX.

Besides the advantage of AJAX, it has a disadvantage such as broser incompatibility issues which is known difficult to debug and maintain.

From the definition and function of AJAX we can imagine the stucture of website with AJAX. This website will be allowed to have a structure like one page website with a function like multiple page website. This structure

is very advanced in website technology.

Think about a single page website that have advance in simplicity and multiple page that compatible with complex system. We can combine the advance from both of them then this web will we have a simple design with a complex function. From here this website structure can be form one or more page and allow to work with complex system such as education platform, market place, and ecommerce.

Important point about this website structure:

- Using AJAX as the core
- Load faster than pure single page structure.
- Simpler structure than pure multiple page.
- Sometimes difficult to debug.
- Harder to build than pure one page and pure multiple page structure. This mean website with AJAX does not simpler to be implemented than other although this structure is simpler than multiple page.
- More effective to implemented in complex system than pure one page.
- Small payload to access whole website than multiple page.

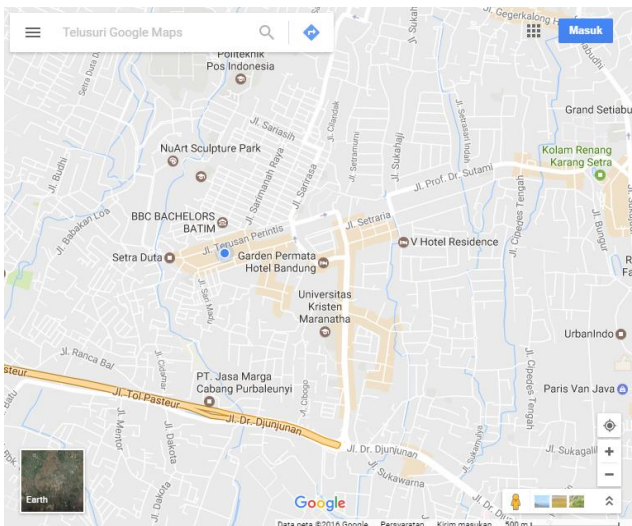


Figure 3.3

<https://www.google.co.id/maps/>
Accessed on 9 December 2016

Google maps is the popular sites provide world map and its details using AJAX. This sites make impression to many people about potential of XmlHttpRequest.

IV. GRAPH THEORY IN WEBSITE STRUCTURE

Graph is one of the great tools to build and manage big/complex website. Small website also match to implemented by graph.

We can think a website as graph that have a direction. This directed graph have a web page as node and edge as provided path to link to other web pages.

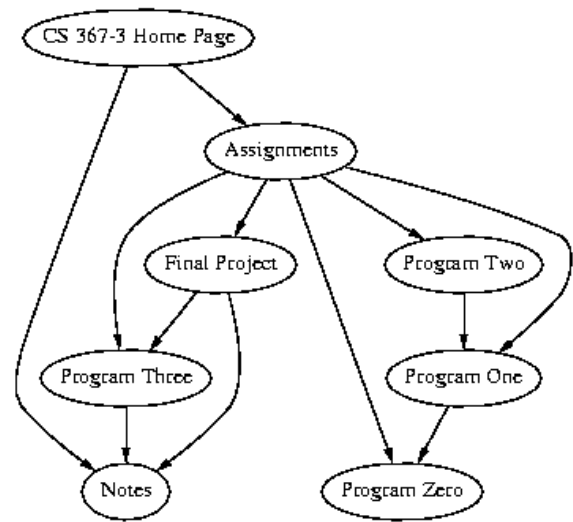


Figure 4.1

<http://pages.cs.wisc.edu/~siff/CS367/Notes/graphs.html> Accessed on 9 December 2016

Suppose we have a website that sell batik clothes and contain some features in the list below:

- Home Page (Start Point)
- How to Order section
- Batik list and prices
- Frequently Asked Question section
- Payment section
- Transaction History
- Account Manager
- Contact

The graph of this website will be different depend on the website structure.

- Using Pure Single Page

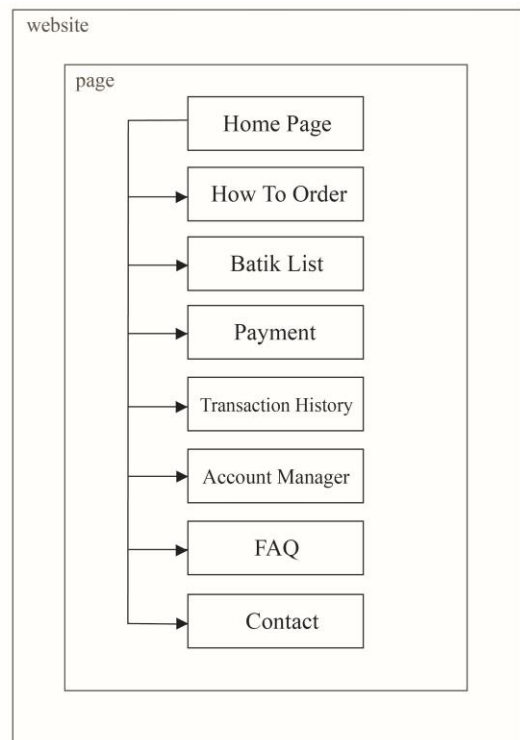


Figure 4.2

2. Using Pure Multiple Page

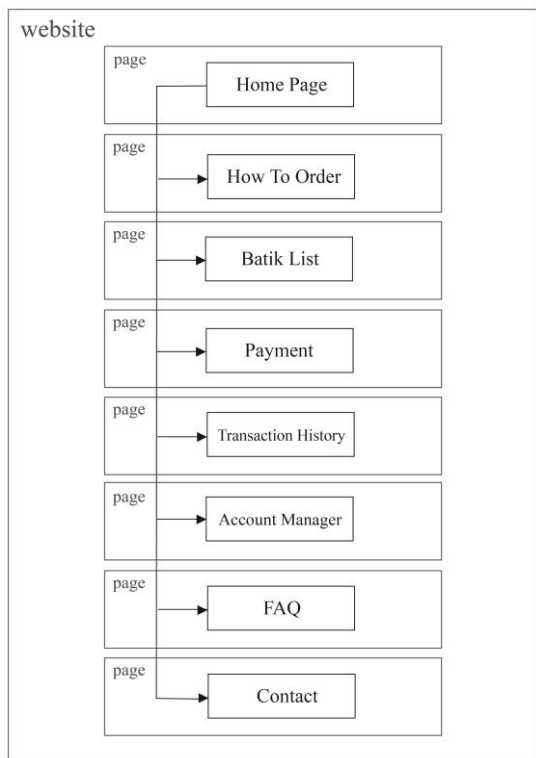


Figure 4.3

3. Using Ajax Website

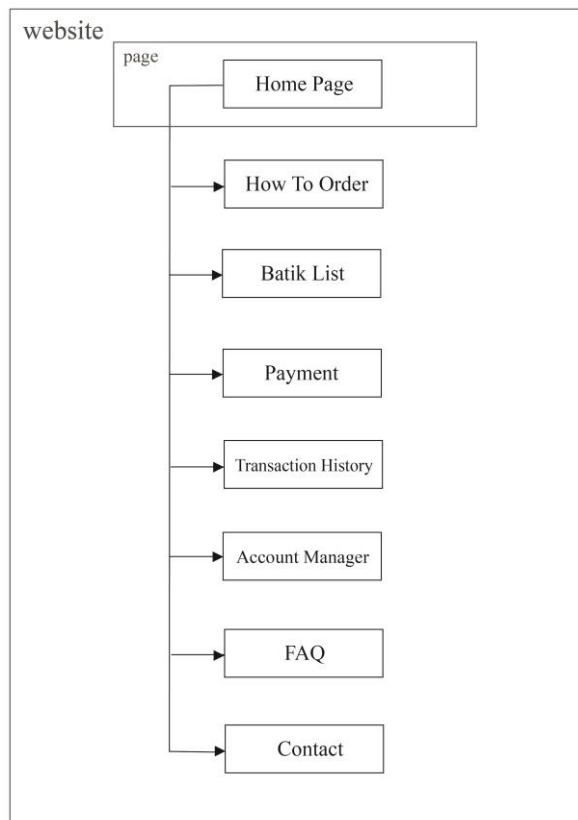


Figure 4.4

When using this AJAX structure, the content will be loaded in one single page. That mean when we start from Home Page then go to Payment section, the Home Page content will be replaced by Payment content and the page background elements is not changed.

V. CONCLUSION

Graph is very useful in various field and often used to solve many problem include to build a website. We can use graph to help us construct a website structure. With help from graph we can get a neat idea and structured plan about our website structure.

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REFERENCES

- [1] *Website*. Accessed on December 7, 2016 from: <http://www.computerhope.com/jargon/w/website.htm>
- [2] *Web Design and Applications*. Accessed on December 7, 2016 from: <https://www.w3.org/standards/webdesign/>
- [3] Munir, Rinaldi. 2003. *Matematika Diskrit Edisi Kedua*. Bandung: Penerbit Informatika.
- [4] Rosen, Kennet H. 2012. *Discrete Mathematics and Its Applications, seventh edition*. New York: McGraw-Hill Higher Education.
- [5] *8 Reasons Why Pageless Design is the Future of the Web*. Accessed on December 9, 2016 from: <http://www.dtepathy.com/blog/design/8-reasons-why-pageless-design-is-the-future-of-the-web>
- [6] *Single-page vs. Multi-page UI Design: Pros & Cons*. Accessed on December 9, 2016 from: <https://www.uxpin.com/studio/blog/single-page-vs-multi-page-ui-design-pros-cons/>
- [7] *AJAX Introduction*. Accessed on December 9, 2016 from: http://www.w3schools.com/xml/ajax_intro.asp
- [8] *What is Ajax?*. Accessed on December 9, 2016 from: https://www.tutorialspoint.com/ajax/what_is_ajax.htm

PERNYATAAN

Dengan ini saya menyatakan bahwa makalah yang saya tulis ini adalah tulisan saya sendiri, bukan saduran, atau terjemahan dari makalah orang lain, dan bukan plagiasi.

Bandung, 9 Desember 2016

Muhammad Rafid Amrullah
13515125