

Develop JavaScript Module for Generating Pie Chart

Wasun Khan-am¹

¹ Information Systems department, Faculty of Business Administration,
Rajamangala University of Technology Thanyaburi, RMUTT
Pathumthani, Thailand 12110
E-mail: wasun_k@rmutt.ac.th

บทคัดย่อ—การนำเสนอข้อมูลในรูปแบบตัวอักษรน่าจะเป็นสิ่ง
ที่ทำให้ผู้รับสารรู้ โดยกลับกันแล้วการนำเสนอข่าวสารด้วย
รูปลักษณะแบบกราฟเป็นรูปแบบที่สวยงาม และทันสมัยกว่า
กราฟวงกลมเป็นหนึ่งในรูปแบบกราฟที่สวยงาม แต่การนำเสนอ
กราฟวงกลมบนระบบเว็บไม่ใช่สิ่งที่ทำได้ง่าย บทความนี้
นำเสนอโมดูลของจาวาสคริปต์ที่ทำให้สามารถสร้างโครงสร้าง
ข้อมูล และโมดูลที่พัฒนาขึ้นสามารถจัดทำโปรแกรมต้นฉบับใน
ภาษาจาวาสคริปต์เพื่อใช้ในการสร้างกราฟ จุดประสงค์สำคัญ
ของโมดูลคือ ในท้ายที่สุดผู้สร้างจะต้องสามารถนำโปรแกรม
ต้นฉบับและโครงสร้างข้อมูลที่สร้างจากโมดูลไปใช้ในการ
สร้างเว็บของตนเองได้โดยง่าย

คำสำคัญ: จาวาสคริปต์, แคนวาส เอชทีเอ็มแอล , แผนภูมิ,
กราฟวงกลม

Abstract—Data presentation by text is very boring for
receiver. In the other hand, graphic presentation is more
graceful and modernize. Pie graph is a one of gorgeous.
Pie graph building on web is a difficult for web author.
This article present a JavaScript module assist graph
builder to build and present pie graph on web. This article
offers JavaScript module enables graph builder to
configure data structure for graph building. The module
also generates JavaScript source code for building graph.
Eventually web author can reuse a generated code
together built module for their own webpage, to recreate
graph. Simple and easy is a major purpose of this module.

Keyword: JavaScript; HTML5 Canvas; Chart; Pie graph

I. INTRODUCTION

A. Background

Web author sometime meet a condition to present a
numeric data. In this case, a number of approaches are
used as a choice for decision such as table, graph, and so

on. One of those approaches, the better way, is using graph
or chart. Graph or Chart is a good way to present data,
beautiful graph may be attracted web users for their
attentions.

Graph or chart creation is not an easy work. Although,
there are a several tools for handling this work, to generate
chart or graph. Those tools are costly and sometime needs
an affordable user. Some tools have a capacity to create
graph but their output is a picture. Some tools generate and
render via internet, in this case, the failure of internet may
be a cause of graph showing. Nevertheless, which type of
tools you use, when data change in not easy to change and
redo a graph/chart.

The research have an idea about HTML5 and canvas
feature is a better way to presents a 2D graphic aspect on
website. This is a good chance for developing pie graph
with HTML5 canvas and JavaScript.

B. Purpose of the module

The purpose of this module is

1. To develop JavaScript module to configure data
for pie graph building
2. To generate JavaScript code to present pie graph
on targeted webpage.

II. LITURATURE REVIEW

To create a JavaScript module require the review
literature in this section.

A. HTML 5

The history of HTML [1] is started from Tim Berners-
Lee, the inventor of HTML, who work at CERN (The
European Council for Nuclear Research). In that time, Tim
have been working on a information management system
to rearrange all document in CERN. He use a HTML as a
tool for running that project. HTML version 5.0 [2], a
successor of HTML 4.XHTML, was started from World
Wide Web Consortium (W3C) workshop in 2004. In that
time, HTML 5.0 is a draft version and in the way to make
a decision, go or no-go. W3C do survey for get a good
direction of HTML 5.0 and the result is a lot of member of
W3C deny to continue develop HTML5.

Although, HTML 5.0 [3] were not supported from
W3C. Many of computer companies including: Apple,

Mozilla, and Opera declared an agreement to continue develop HTML 5.0 under the new workgroup named WHATWG.

In 2006 [2], W3C get back to the project of HTML 5.0 and release a new standard of HTML 5.0.

HTML 5.0 [2]-[3] have a several new feature added on. One of those feature is having CANVAS, feature to render graphic aspect on HTML without three-party.

B. Canvas

Canvas [1], [3], as mention above, is a one of new feature that add on HTML 5.0. This feature allow programmer and web authoring also to use any script language to create graphic aspect on webpage. This canvas area look like a real canvas for painter who paint a picture. Different between real canvas and HTML 5.0 canvas is how it is used. In real canvas, painter use brush for drawing and painting. In HTML 5.0, programmer or web author use script language and HTML 5.0 API to drawing and painting. HTML 5.0 canvas is a bitmap high-resolution canvas.

However, using canvas help web author and programmer to create graphic aspect. But if there are any HTML element that can use for that feature, web author should use those feature.

The canvas element syntax in HTML 5.0 is

```
<canvas id="" width="" height="">
```

Last thing to remember about canvas, programmer or web author should use any script language to create graphic aspect.

C. JavaScript [4]-[5],[7]

JavaScript is a lightweight, interpreter, first-class function language. JavaScript is known as a web script but JavaScript can use in many way as a node.js, and Apache CouchDB. JavaScript is also prototype-base, multi- paradigm, dynamic, object-oriented, and emphasis on function type

In this article, Programming in JavaScript is a key operation.

D. Create Graphic Aspect in canvas [1]-[3],[6]

The sequence of operation to create graphic in HTML5.0 canvas is

1. Create/Find canvas
2. Get drawing Object
3. Set attribute of drawing
4. Draw on canvas
5. Repeat Step 3 to 4 until finish work.

The API using in this article include:

TABLE I. CANVAS API

API	Meaning
getContext('2d')	Gets drawing object from canvas
beginPath()	Begins a path, or reset the current path
moveTo(x,y)	Moves to coordinate x and y
arc(x, y, r, b, e, t)	Creates circle/parts of circle at center point x, y radius r start angle b and end angle e with t direction
fillText(s, x, y)	Draws text (s) at coordinate x, y
fil()	Fills a current drawing
stroke()	Actual draws a current drawing
measureText(s)	Returns an object contains the width of parameter s

The arc() API using angle from x-axis, 0π in radian degree, and continue direction in clockwise as this example



Figure 1. Drwaing direction of arc() API

E. Pie Chart

A pie graph or pie chart is a specialized graph used in statistics. The label of each data is plotted around a circle in either a clockwise direction or a counter-clockwise direction. The data are transform to a part of circle, called "slice". The relative sizes of the area, central angle, of the slice correspond to proportions of quantities. The next figure show sample of pie-graph.

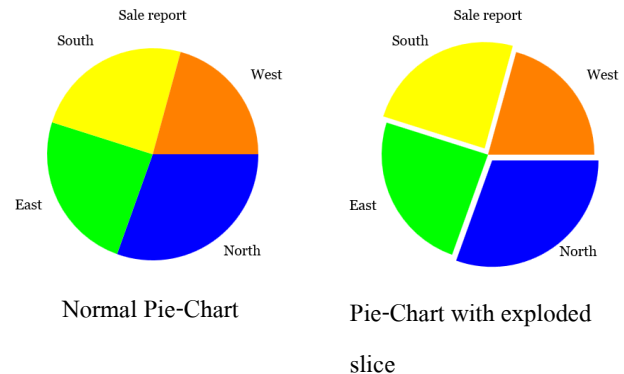


Figure 2. Pie Chart Example

III. DESIGN

A. Requirement specification

To develop JavaScript module, the basic tools require: apply JavaScript object-oriented by prototype-base feature, HTML DOM, and together with HTML 5 canvas. The requirement of this development have been specified and shown in the next table.

TABLE II. REQUIREMENT SPECIFICATION

Seq.	Requirement
S01	Create JavaScript Module as a tools for graph configuration via web page
S02	The tools in S01 work on a client-side only , and no need server-side
S03	Be able to generate JavaScript Code, and the code will use to present graph on targeted webpage
S04	Allow builder to save a pie graph
S05	All multi-create graph in same web browser

B. Equation

The first equation is identify a number of radian degree. From a theory of circle, all inside angle of circle is 360 in matric degree or 2π in radian degree, the data can create part of circle using angle by this equation:

$$\theta_i = 2\pi x_i / \sum x_i \tag{1}$$

When

$$\sum \theta_i = 2\pi \tag{2}$$

Where

θ_i angle of i^{th} data
 x_i is i^{th} data

For create segment split from base graph use a follow equations:

$$\omega = (\theta_{end} - \theta_{begin}) \tag{3}$$

$$\delta x = \Delta \cos(\theta_{begin} + \omega/2) \tag{4}$$

$$\delta y = \Delta \sin(\theta_{begin} + \omega/2) \tag{5}$$

Where

ω is a size of angle in this slice
 Δ is a gap between exploded slice and normal slice
 δx is a transformed gap size in x-axis
 δy is a transformed gap size in y-axis

C. Program Design

For program designing, there are 5 diagrams as: use case diagram as show in figure 3, class diagram in figure 4, and three sequence diagrams in figure 5 – 7. all diagram show in next.

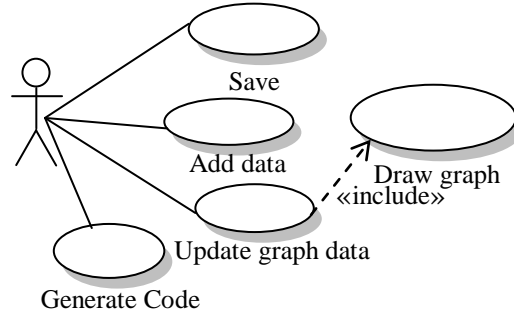


Figure 3. UseCase diagram

In use case diagram showing above, there are four major tasks in this module as: *Update graph data*, *Add data*, *Generate code*, and *Save*; and there is one supported task, *Draws pie graph*. Every time *Update graph data* is fired, it will automatically include *Draws graph* in its' task.

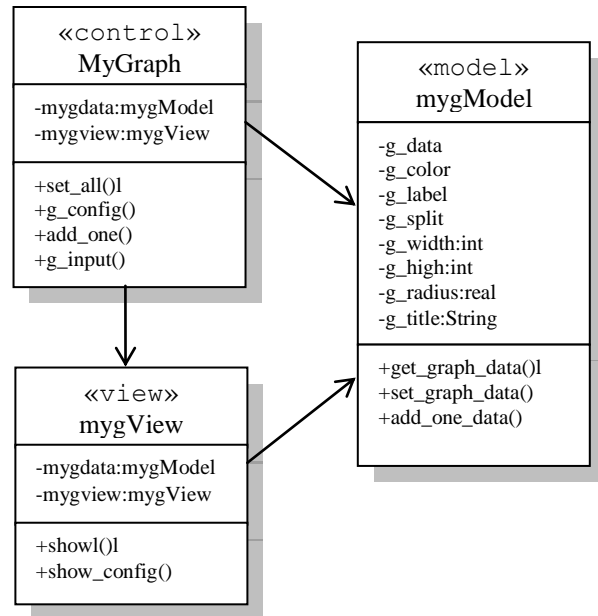


Figure 4. Class diagram

Figure 4 shows all classes and relationship among classes. There are three classes in this module including *myGraph*, *mygModel*, and *myView*. After develop use case and class diagram, the result of these diagram drive to create next three sequence diagrams in next figure:

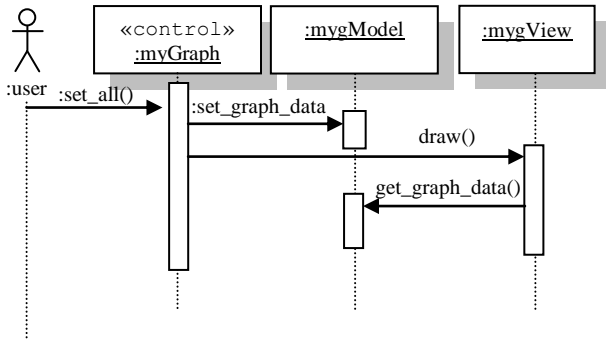


Figure 5. Change II sequence diagram

Figure 5 how module response with click Change II button event

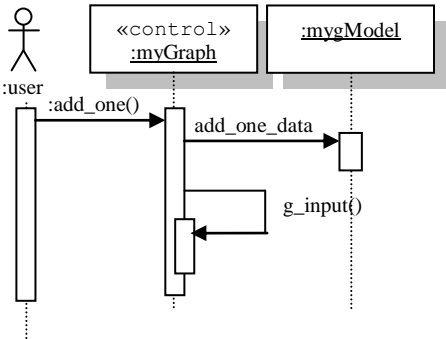


Figure 6. Add one sequence diagram

Figure 6 how module response when button add on click event is fired.

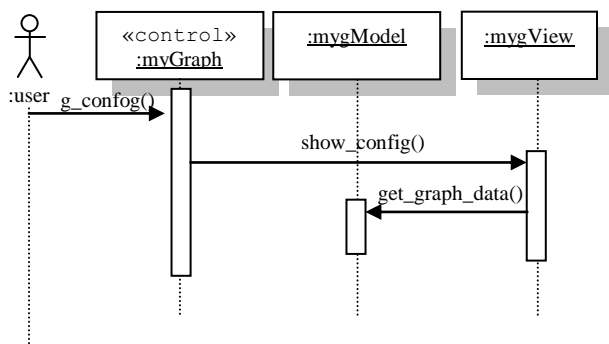


Figure 7. Show config sequence diagram

Figure 7 how module response when show config button is fired.

IV. RESULT

When a module completely developed, the final JavaScript module names mygraph.0.2.1.js, with a setup html file names setup_pie.html was created. User start program by create data for graph. Open web browser and navigate to html file. After setup html load and start a web browser is going to show screen in figure 8.

There are four part of program in figure 8 including: general data area, data area, graph present area and command area.

In general data area, user can set div tag id by input box next to *DIV ID*, set graph name by input box next to *TITLE*, set graph width by input box next to *Width*, set graph height by input box next to *Height*, set radius of graph by input box next to *Radius*

In data area, user can set caption of each data by input box below *Label*, set genius data of each slice by input box below *Data*, determine exploded slice or not by check box under *Split*, and set color of each slice by input box under *Color*.

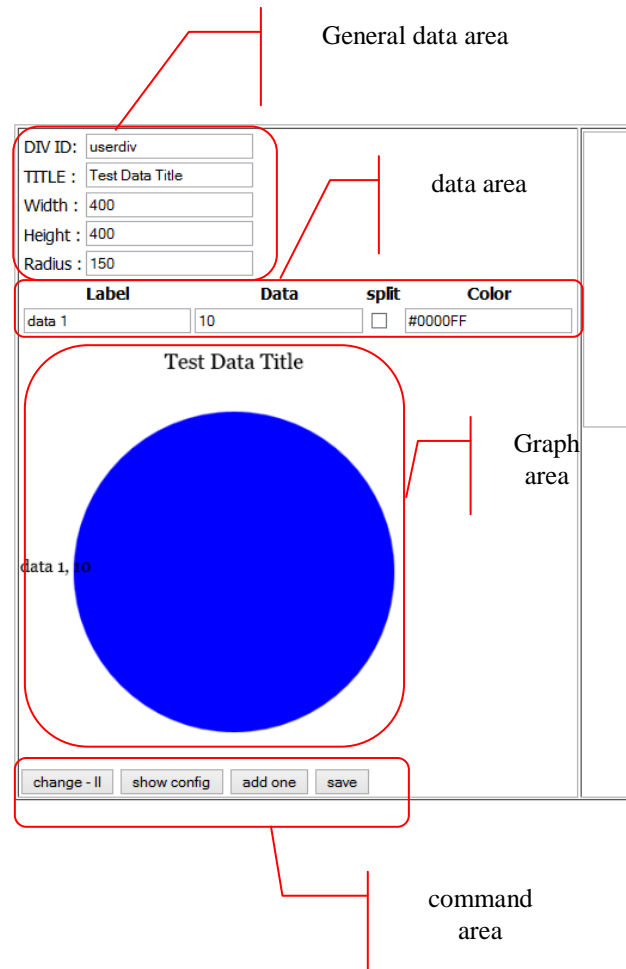


Figure 8. Setup_pie.html in IE9

In command area, clicking button label 'Change II' clicking, will apply all data those are specified in all fields to redraw pie graph in graph present area. By clicking button label 'show config' clicking, the module will generate JavaScript code in HTML-text area on the right side of screen. By clicking button label 'add one' module will add new line of all data above. By clicking button label 'save', module will prompt user for save current chart. The figure 9 is a sample of module usage with sample data in all fields.

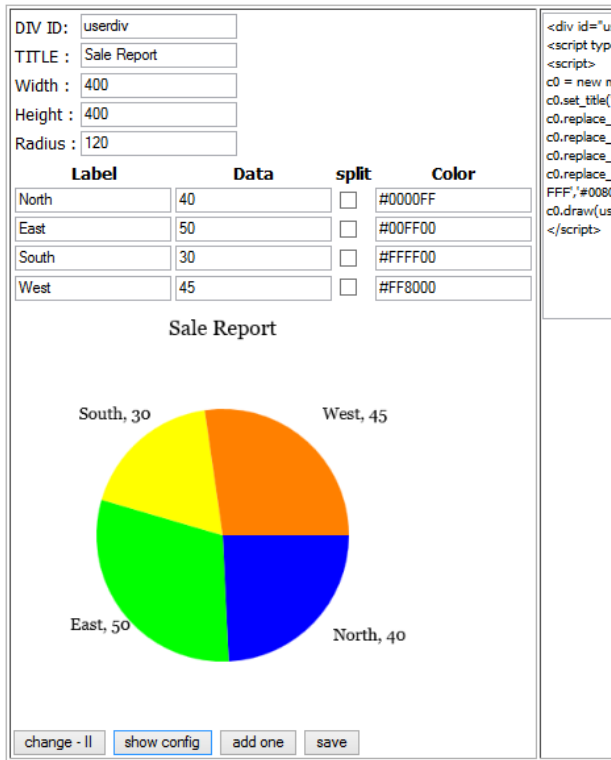


Figure 9. Sample of module usage

By clicking button 'show config', the module generate JavaScript code and shows those code in the next figure will display on the right-side of the web browser.

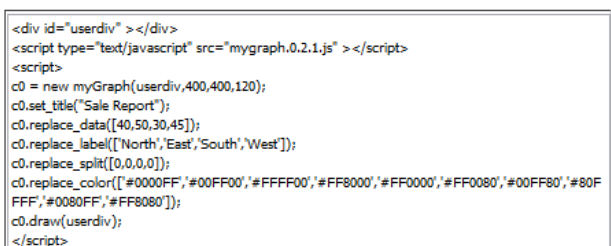


Figure 10. Output of generated JavaScript code

V. CONCLUSION

When module was developed, the module itself together with its HTML file have been tested. The result of the test demonstrate that, the module capability meet a pre-determined requirement specification. The JavaScript source which is generated from module is able to reuse for presenting pie graph completely and perfectly on webpage.

VI. PROBLEM AND OBSTACLE

Some of problem and obstacle found during this development are:

1. During create an html file, the innerHTML property is not available for all web browser, it is good for Mozilla Firefox but it is not good for Chrome, IE, and so on. The good way to create element dynamically for all web browser is using createElement() and their relevance method.

2. The graphic aspect creation in canvas is always connect together. If developer need to split one aspect at the time, please use beginPath() to end the old graphic aspect, and start the new graphic aspect.

3. Saving picture or image from canvas is possible. But it is not allow developer to specific name of file, user has to specify filename by himself/herself. Moreover, saving picture does not allow for all web browser. User may counter nothing happens when run this feature with Internet Explorer, and some other.

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