Universidad Carlos III de Madrid

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Ingeniería en Informática

PROYECTO FIN DE CARRERA

Developing a Heavy Client-Side Web Application: ScaleNet

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Agradecimientos

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Resumen

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Abstract

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Introduction and Objectives

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Chapter 2

State of the Art

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2.1 Push Server: the APE Server

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2.2 JavaScript Framework: MooTools

Before explaining why MooTools has been chosen for this application, another important question has to be resolved:

2.2.1 Why Use a JavaScript Framework?

There are several reasons that lead to this conclusion, the most important are:

- Because we want to support different browsers. If we do not use a framework a lot of time would be spent debugging the huge differences between Internet Explorer and the rest of the browsers.
- Because we want to facilitate the development, since usually these frameworks cover several holes in the JavaScript specification that allows us fixing common issues with less code.
- Because we want the interface to have advanced effects. We could just search for several scripts that makes one individual effect, but that will result in redundancies, differences in quality code and waste time in searching.

2.2.2 Making the Decision

By the previous standards, we have plenty of options to choose from: jQuery[1], Prototype[2], Dojo[3], YUI[4], GWT[5], Ext JS[6], etc. Overall, these are very popular and they offer high quality and plenty of functionality. However, for this particular project, and after some consideration, MooTools [1] was considered the best option. The reasons for this decision are:

Compact It has a low footprint on the site load because it is reasonably lightweight for the functionality it offers. Particularly, it is more optimized in this aspect than Prototype, YUI or Dojo, but it is also slightly more compact than jQuery.

Modular-Based Because of that, the installation can be customized to get only the modules we need, and the creation of our own extensions is easier.

Compatible It has been tested with most browsers: Internet Explorer 6+, Firefox 2+, Opera 9+, Safari 2+ (and other Webkit-based browsers, like Chrome).

[1] jQuery is available on: http://jquery.com/
[2] Prototype is available on: http://www.prototypejs.org/
[3] Dojo is available on: http://www.dojotoolkit.org/
[4] YUI is available on: http://developer.yahoo.com/yui/
[5] GWT is available on: http://code.google.com/webtoolkit/
[6] Ext JS is available on: http://www.extjs.com/

Functional It offers all the functionality required for the first phase of the project: drag&drop, resize, animations, etc.

It also offers other functionality like AJAX support, Hash handling or Cookie handling, that ease the development in different browsers.

Object-Oriented By adding *Classes* to JavaScript, an abstraction that it is perfect for this application, since the server code is written is Java.

This way, we can use similar concepts both in the server and in the client. Moreover, the inherited code for ScaleNet already used JavaScript objects.

Extensive It also has a repository for official plugins called MooTools More (with similar code quality and documentation to the MooTools Core) and other third-party plugins can be found in the web.

Well-documented It has extensive documentation for every class of the framework.

Well-structured Its structure is perfect for a professional web application. Frameworks like jQuery are more focused in reducing the lines of code that in encouraging robust coding. MooTools also helps reducing the lines of code, but it has more tools for writing code in a very modular, reusable and robust way, for example by using classes and other abstractions.

It also improves the readability of the code, something hard to do in JavaScript. Another important point of this framework is that it is based on prototype extensions (mainly `DOM` extensions), so the syntax is very Object-Oriented and the code seems very clean.

Used by the APE server (See Section 2.1) So if we use that component, it will be very straightforward to write extensions in JavaScript also in the server. This will mean that we could use the same coding style and the same tools in the server as in the client.

Chapter 3

Development

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3.1 How the Devices Are Placed

The first time that the user visits the page in a new browser, the system has to place the devices in the screen. Since the number and type of devices are different for each user, an algorithm must be used to placed the devices in the available space.

3.1.1 Simplified Algorithm

The restrictions that we have to comply are:

- We have an undetermined number of elements to place.
- For the sake of simplicity, the elements and the canvas are rectangular.
- Every element, including the canvas, has a different size.
- We have to place them in the most comfortable way possible, ideally using all the space we have.

The solution to the above problem is known as a variant of 2-D rectangle packing and it is, regrettably, NP-hard. At this point, it is clear that we need a simplification. Furthermore, the original problem also presents a big issue, as it does not address an important constraint: the possibility of resizing the elements to fit the canvas.

A simplified algorithm is proposed and implemented, relaxing some terms while obtaining acceptable results. The important concepts are:

- The main goal is to draw a virtual grid of M×N cells (like a table). Every cell can be a position for a device.
- Indeed, we are going to calculate the smallest grid of M×N cells in which the devices can be placed.
- Finally, we are going to resize the elements to fit within that cell, giving that every cell has the same size.

To obtain the squared grid for N elements, we simply have to calculate the ceiling of the squared root of N as seen in (3.1).

$$Grid_x = \lceil \sqrt{N} \rceil \tag{3.1}$$

This formula synthesizes the idea that, given a certain number of elements N:

- If N is a square number (that is, it exists an integer x that fulfills $x^2 = N$), then you could fit a whole grid of $x \times x$ with N elements.
- Otherwise, this integer N must be between the square of two consecutive integers, that we are going to call x and $x + 1$. That is, $x^2 < N$ and $(x + 1)^2 > N$. In visual words, that means that a grid of size x cannot hold that number of elements, and a grid of size $x + 1$ can hold that number of elements but there will be empty *cells*.
- In that case, we choose the grid of size $x+1$, this way we want to apply the ceiling function to the squared root to obtain the next following integer.

In the following figures we can appreciate what all of this means with real examples, using different number of elements.

(insert images with the disposition of different number of elements in the grid)

If we look at the examples below, we can guess an improvement without making the calculation severely complicate. We can see that, at certain points, a whole row of the grid is completely empty, so we are wasting vertical space. In theory, we could detect when this happens and try to reduce the vertical height of the grid by one, effectively converting this squared grid into a rectangle grid with different number of columns and rows.

Parting from an example: if we have $N = 19$, then we obtain $x = 5$ by applying the previous formula. This will lead us to a 5x5 grid, but the last row will be completely empty. The question that we have to ask ourselves is:

how big has to be the rectangle grid in order to be able to place this number of elements? Briefly, the answer is $x \cdot (x-1)$. That is a mathematical way of describing that we are decreasing the number of rows by one. In this case, we need a grid of 5×4 elements: that will hold up to 20 elements.

To discover whether we have to decrease the number of columns or not, we must compare that number $(x \cdot x - 1)$ with the actual count of elements. If we know that this number is bigger or equals to the number of elements, then we know that a grid of $x \cdot (x-1)$ elements can hold those elements. On the contrary, if we know that this number is strictly lower than the number of elements, then we know that a grid of $x \cdot x$ is unavoidable. This can be formulated this way:

$$Grid_y = \begin{cases} Grid_x - 1 & \text{if } N \leq Grid_x \cdot (Grid_x - 1), \\ Grid_x & \text{if } N > Grid_x \cdot (Grid_x - 1). \end{cases} \tag{3.2}$$

Another question appears: Do we need to shrink the grid only by one? Is there any case in which we have to shrink the grid by two or more?

The answer is no.

We can prove why not by calculating if a grid of $(x-1) \cdot (x-1)$ elements can hold more elements that the grid of $x \cdot (x-2)$. If that is the case, then we would not need to shrink the grid in any case by two because the grid will be already horizontally shorter. It is quick to prove this is true following the steps explained from (3.3) to (3.5).

$$\begin{align} (x-1) \cdot (x-1) &< x \cdot (x-1) \tag{3.3} \\ x^2 - 2x + 1 &< x^2 - 2x \tag{3.4} \\ 1 &< 0 \tag{3.5} \end{align}$$

Then, using this final algorithm, the previous examples will change:

(insert images with the disposition of different number of elements in the grid using the final algorithm)

Using this algorithm we can calculate the height, width, vertical and horizontal offset for every element. If we want to work with percentages, we only have to divide the size of the container between the number of columns and rows. For example, if we want to fill the container at 100%, then every element will be of size $100/x \times 100/y$. The actual values for the offset needed for every particular element is then easy to calculate if we fill the canvas one by one.

3.1.2 Storage Positioning

Next time an user visits this page, the system will remember the last position of those elements instead of calculating the grid again. Because the user can change the size of the window at any time, we cannot relay on fixed positioning with pixels, because our canvas could be bigger or, worse, smaller than the one we have calculated. Besides being not very elegant, we can find several situations where the page is unusable.

The best way to avoid all that trouble is treating every position or size in terms of percentages. This is how is done in the code, and it allows the user to resize the window at any time: the devices will be resized dinamically according to that window size.

To store and retrieve painlessly these values, we are going to take advantage of an useful MooTools class: `Hash.Cookie` [2]. With this utility, we only have to specify the name for the `Cookie` and we can store a `Hash` into a `Cookie` without worrying about the `Cookie` itself. Besides loading the data of the `Cookie` directly on the `Hash` at its creation, if we change a value of the `Hash` it will be automatically updated in the `Cookie`.

The reason for using a `Cookie` is mostly because it reduces complexity on the server, since it does not have to store the position of every device. Other good reason is that it is the most simple way of allowing different arrangements in different places; for example the user may want to arrange radically different its devices in a big screen like in a TV or on a smaller screen like in a netbook. Finally, it is universal as it is supported by almost every browser.

The final decision is to have one `Cookie` for each device. This is very straightforward for the implementation, since a `Cookie` can have the name of the container. Each `Hash` that is stored in every `Cookie` is composed by the four values needed for positioning the element: `offsetX`, `offsetY`, `width` and `height`. These values are percentages respect the container (the devices list) and an `Hash` example is presented in Listing 3.1.

Listing 3.1: Cookie Hash example

```
{
  offsetX: 15,
  offsetY: 50,
  height: 10,
  width: 20
}
```

Then, each time the object size or dimension changes, the `Hash` (and therefore the `Cookie`) is updated. These changes happen mostly in two situations: when we resize a device (changing its size but no its position) or when we move around a device (changing its position but not its size).

3.2 APE Server Installation and Configuration

In this section the installation and configuration of the APE server are defined step by step.

3.2.1 Install the Server

The APE download page [3] contains packages for different operating systems and architectures. In this case, since the system is Debian-based we should use the DEB package. Once the correct package is downloaded, it can be installed on the Application Server by typing Listing 3.2 from the same directory as the package is stored.

Listing 3.2: APE installation command

```
sudo dpkg -i ape-1.0.i386.deb
```

After that, the APE server daemon (`aped`) is automatically started with the default configuration [4]. It can be checked by visiting the url `webportal.imusu.mobile.dtrd.de:6969`.

3.2.2 Configure BIND

The IMS core is the machine that provides the `DNS` service through `BIND`, and that service needs to be configured to allow the APE server to use a lot of different dynamic subdomains like `1.ape.webportal`, `2.ape.webportal`, `567.ape.webportal`, etc.

This is how the APE server works by default, and it appears that there is no way to configure the APE server for using only one domain [5].

So, in the file `/etc/bind/imusu.dnszone` located in the IMS core we have to look for the *webportal* entry and change that section to look like Listing 3.3.

Listing 3.3: BIND configuration

```
webportal          1D IN A       192.168.5.234
ape.webportal      1D IN A       192.168.5.234
*.ape.webportal    1D IN CNAME   ape.webportal
```

To apply the changes, we have to restart BIND using the command in Listing 3.4.

Listing 3.4: BIND restart command

```
sudo /etc/init.d/bind restart
```

Chapter 4

Conclusions and Future Work

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Appendix A

Budget

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Appendix B

One More Thing

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