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A Proposal of Generic Models for Adaptable Web Applications

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Abstract: Web applications experience quite significant growth in attractiveness. They are currently developed for many purposes and by various groups of developers. Simultaneously, new technologies associated with the HTML5 specification have emerged. These technologies bring new functionalities available for web applications. Therefore, the main objective of this manuscript is to present three generic models (templates) that can be instantiated during development of web applications with particular functionalities. These models are focused on geolocation data, tracking and off-line access. Since, the models are general in nature, they are associated with various limitations and issues which are depicted in the paper. However, they represent quite promising starting point for further research activities that are outlined in the paper as well.

Key words: Geolocation, tracking, off-line, web application, adaptability, technologies, functionalities

INTRODUCTION

Web applications have experience quite significant growth in popularity recently (Prokhorenko *et al*., 2016). This fact might be evidenced by usage of applications dealing with news, weather forecast, business information or interaction with friends on social networks (Kim *et al*., 2016; Hernandez, 2016). Thus, in information-based society, development of web applications represents one of the most important skill. Several technologies such as cookies, SSL (Secure Socket Layer), CGI (Common Gateway Interface) or JavaScript have been introduced and used from the launch of the first version of the HTML (Hyper-Text Markup Language) at the beginning of 1990's. Expansion of particular technologies and internet access to the public brought the request to dynamically process data on the server side. Simultaneously, new languages or client technologies have been continuously improved. As a result, users started to appreciate features such as centralisation of the business logic (the application logic is located in one space and the client-server architecture is prevailing), thin client (internet browsers available in all operating systems are used for the work with web applications) and hardware management (technical server parameters are known in advance, thus, the web application installation on server can be based on the most suitable configuration).

However, there are also weak points mostly tied to architecture related to web applications. Security or technological limits of the HTML can serve as examples.

Due to aforementioned advantages, three main aspects of web applications-usability, aesthetics and information side6 are quite intensively developed not only by software engineering organisations but also by individuals, students or just enthusiasts in this field. The main objective of this study is to present models for adaptable web applications available for all these groups of developers. The main idea follows research by Zhang and Takada (2016) who work with pre-defined templates for web application user interface. In this study, this idea is slightly extended to the area of functionality and adaptability. The fulfilment of this objective is grounded in establishment of generic models (templates) available for solutions that need to be created under specific circumstances.

MATERIALS AND METHODS

Adaptability of web applications: To overcome certain types of limitations the adaptability of web application is usually developed and applied. Adaptability represents one important issue that pleases the web application's users and draws their attention. Some approaches were developed in order to introduce adaptation into web development cycle (Mannava *et al*., 2011) but they imposed some drawbacks in that they drag cross-cutting concerns into applications limiting their reusability and maintainability. Moreover, when adaptability is not considered from the early stages of development, the requirements traceability and thus the system evolvability are limited (Dargham *et al*., 2011). In this context, the

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adaptability is considered as an ability to adjust to the targeted environment (Tucnik *et al*., 2014). Certain level of adaptability can be found in basics of web pages where the browser is responsible for interpretation of the content and its visualisation. From this point of view, the adaptability might be classified to the following categories.

Appearance adaptability: It is based on adjustment of the web page appearance connected with the process of its creation. The first real adaptable mechanism was represented by media in the CSS (Cascading Style Sheets) Version 2 (1998). Possibilities brought by the second version are also supported and further strengthen by the third version. Thus, the web page appearance can differ not only in PC or a mobile device but also in different types of mobile devices.

User adaptability: The web application accommodates to particular users at this level. If their identity is known, personalisation of information or application settings can be applied. The main aim is to adapt various application functions such as interface for email application in which individual folders, filters, warnings, etc., might be set.

Functional adaptability: This type of adaptability is closely tied to used technologies (HTML5, JavaScript, CSS3) and take advantage of their main characteristics. With their help, application for movies editing, graphics development or tracking of objects in real-time can be created and implemented.

Interoperability adaptation: Since, there is a growing number of services freely available on internet, large providers of such services (e.g., Google, Dropbox, Facebook or Twitter) enable to work with API as another web service. Thus, it is possible to integrate such services into newly developed web applications. Usage of geocoding mechanisms, synchronised storage areas. Or identity verification can serve as an examples.

RESULTS AND DISCUSSION

In this study, selected models of adaptable behaviour of web applications are presented. Models represent solutions that are based on newly supported client technologies together with a proposal of the server side of the application which comprises adaptable mechanisms.

Displaying influenced by geolocation data: Geolocation data plays an important role in this model. First of all, there are certain limitations that need to be considered:

- A user must enable the web page to acquire geolocation data
- The web page must be able to ascertain geolocation data entirely after its downloading, thus, it is not possible to rely on these data in association with the first query
- The positioning can be time consuming and accompanied by various errors (time expiration, location in invisible area, etc
- After successful location the coordinates must be shared with the web application with the help of an AJAX (Asynchronous JavaScript and XML) query

This model is generic in nature and does not solve any particular task. However, its slight modification enables its usage in many instances. Figure 1 illustrates the process of geolocation data inclusion in the web page display. In the first stage, the client system requires a web page which is consequently provided. Script associated with this web page tries to localise the user. This operation is asynchronous and it is thus, difficult to estimate its time duration. If not successful, this process is terminated. In the opposite case, the location is dispatched to the web application in a form of asynchronous request. This request is processed by the web application in cooperation with a data storage. The response comprises data that take into consideration the user location. This response is then integrated into the web page. A server with weather forecast data which displays weather forecast for the locality in which the user is currently situated can serve as a functional example.

This model enables to modify web page displaying based on the user location. In practice, this principle can be used in the following systems:

- Context-based portals focused on, for example, restaurants, other gastronomical spots, pharmacies, shops, etc
- Instantiation of general queries in web browsers
- Managerial web applications supporting planning and decision-making (e.g., determination of the nearest point of action during the terrain work)
- Registering of participants which might be supported by other techniques like QR codes

Tracking system as a web application: Position tracking represents a research subject that is quite intensively investigated (Masek *et al*., 2016). The main idea of this model is based on a proposal of a tracking system which would be available in a form of a web application. Such proposal would enable to use functions

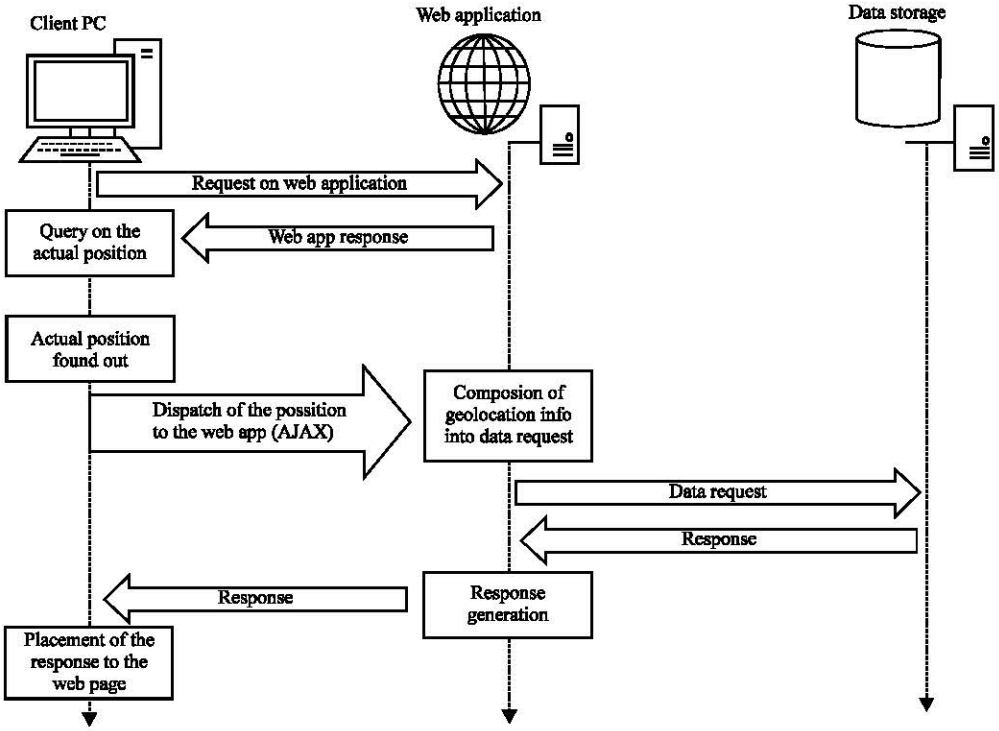

Fig. 1: Adaptation based on geolocation data

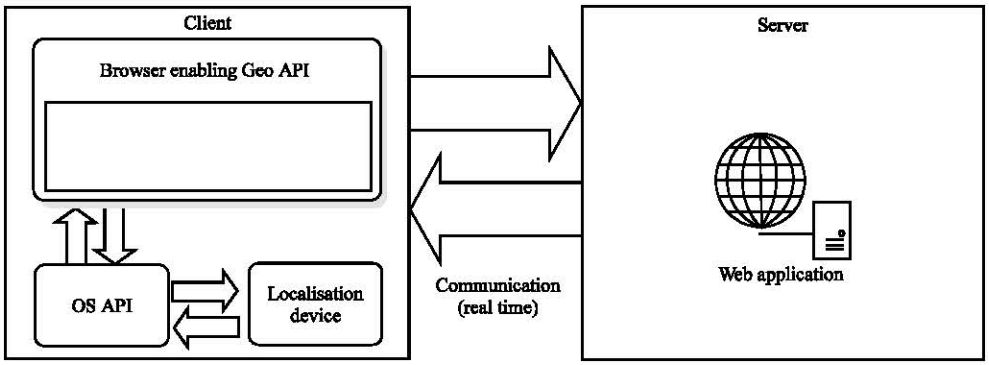

Fig. 2: Tracking system as a web application

provided by native mobile applications without necessity of installation. The model is depicted in Fig. 2.

The client part of the web application is developed according to the HTML5 specifications. Thus, it is necessary to use a web browser supporting this technology. The location is found out at the client side. It is consequently dispatched to the web application with a certain periodicity. This model of a tracking system can implemented in application of parcels monitoring, business transportation systems or in social web applications which can reveal who from the other users is located in close surroundings. Limitations associated with this model are related to limitations of web applications. Furthermore, it is necessary to consider the fact that some mobile browsers do not let the JavaScript thread running if it is not active. In this case, the communication with the web application is terminated.

Off-line access: Model of off-line access describes a way which suggest quite comfortable mechanism for automatic storage of parts of a web page into the off-line storage. This is executed in the way to have these data available even in case of deactivated access to internet. Figure 3 depicts the possible appearance of the page dedicated to off-line access.

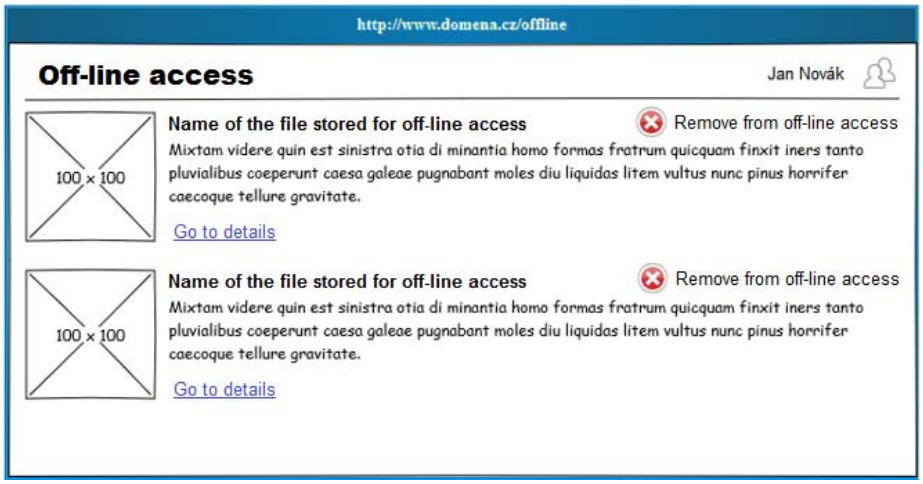

Fig. 3: Off-line access interface

The model is based on the application cache technology that is directly focused on off-line access to web pages. If a page is stored in the application cache, the browser takes responsibility of its displaying even in case of missing access to internet. The application manifesto represents the key file responsible for determining which files (web pages) should be available for the off-line access. Considering the mechanism used for management of data storage, it is suitable to create a separate web page (Fig. 3). This page contains the manifesto file. This file is generated dynamically according to user preferences. The manifesto file name is change in case of any change of user preferences. In this way, it is ensured that the browser downloads the new version of the off-line content.

Management of the off-line content can have quite simple structure-a button "available off-line" can be used at selected web pages. In pushing will:

Redirect to the page with settings

Page settings logic:

- Add the required page on the list of the off-line content
- Generate a new manifesto file in which the new page will be occur
- Set the new unique name to the manifesto file
- Display of the page "/offline" which will enable downloading of all files stated in the manifesto

Redirect back to the original page: Procedure focused on the removal of the off-line content might be similar:

- Pushing the button will call page that will be marked as prohibited for off-line access
- Inner logic will remove the page from user settings
- The next steps are identical with those from the previous procedure starting with Step 2

This model proposes a simple implementation of management of the off-line content which is under user's control. In this way, it is possible to select any part of web and store it locally for later off-line browsing. It is only necessary to add "/offline" behind the URL in the domain address.

CONCLUSION

Web applications represent a widely spread tool that is used by many user for various purposes. This variety needs to be supported by the flexibility of application which should be adjustable to the specific circumstances, needs and conditions. Therefore, the main aim of this study was to present three generic models which should ensure adaptability of web applications. Models focus on displaying of information influence by geolocation data, tracking system in a form of web application and off-line access to the web content. Presented general models are closely associated with the newest technologies supported by the HTML5 specification and represent general frameworks which can be both instantiated and more generalised in case of necessity. There are certain limitations associated with model which can be classified to technical risks and social issues (Apaolaza *et al*.,

2013). However, all can be overcome and thus potential research directions outlined in the previous section can be successfully realised in the future.

LIMITATIONS

All presented models are closely tied to technologies associated with web applications. Similarly, the level at which these technologies are supported by all web browsers is also crucial. Although, technologies used for development of presented models are widely supported by main web browsers, users usually do not keep their browser's version up-to-date. Usage of obsolete version might make certain troubles when the models would be intended to be implemented. Hence, the greatest limitation is connected with disability of a browser to run required functionality. This technical type of limitation might be accompanied with soft social issues 13 such as unwillingness of users to enable running of specific required functions (e.g., start location or tracking services). In such case, technical solution, although prepared for application, would be useless. Moreover, measuring the complexity and reliability of the system and testing every possible sequence of events are important issues regarding web applications. Thus, there is a need to identify and analyse the potential failures of the system. Application of models in practice will consequently reveal, if there is any need for improvements. There are also other risks associated with research in the field of adaptable web application. For instance, the key technology can be removed from the standard (the case of Application Cache can serve as an example), user's support of key technologies can be insufficient or users can be confused (models influence basic principles, on which web applications are based; hence, there will be very likely a need to slightly change behavioural patterns connected with work on the web).

RECOMMENDATIONS

There is a plethora of paths which might be used in further research activities. Each presented model and technology has a potential to be used in many specific applications. For instance, research focused on the usage of the WebGL technology in specific educational or visualisation situations, games, multimedia applications can take place. The circumstances are similar in case of adaptable mechanisms. Proposed models can be both specified and generalised. Furthermore, algorithms associated with models can be improved and optimised.

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