Interaction Patterns for Designing Visual Feedback in Secure Websites

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Abstract — **In a website, it is essential to offer accessible and secure online services for end users. In general, usefulness and usability aspects are taken into account during design of website, but security issues normally are put aside. The specification of visual feedback helps the analysis and design of websites. This paper proposes a set of best practices of visual feedback for designing websites where the user task can be made secure and usable.**

Keywords-secure website; interaction patterns; visual feedback; software architectures

I. INTRODUCTION

Online services, such as a bank transfer or a virtual meeting, must be executed in a secure environment. In fact, user tasks are constantly exposed to threats either in a simple or complex online service. Here are some examples of threats:

- **Guessing threat**: Here the intruder tries to guess the password that protects the computer network in order to gain access to it.
- **Spoofing threat**: The goal of this attack is to usurp an authorized IP address and to gain access to the victim's system. The IP spoofing attack is often called blind spoofing, and is using against communication services taking advantage of their security vulnerabilities (e.g., rsh, rlogin, and rcp attacks). This allows the intruder to hide the origin of his attack (used in Denial Service attacks). Denial of service attacks typically involve an attacker disabling or rendering inaccessible a network-based information resource.
- **Scanning threat**: The intruder goes about scanning different ports of the victim's system to find some vulnerable points from where they can launch other attacks, (e.g., port-scan). The scanning and the spoofing attacks may be consider more risky, because usually are the preface for other attacks.

A large variety of design techniques for specifying websites exist but they have limited consideration of security aspects [3]. In general, usefulness and usability aspects are taken into account during design of websites but security issues normally are put aside. We consider that the secure aspects of a website can be specified in an explicit manner through its Graphical User Interface (GUI) in order to offer the end user more secure, reliable, and comprehensible online services. In a GUI, it is possible to use some metaphors and colors to notify the end user about detected threats.

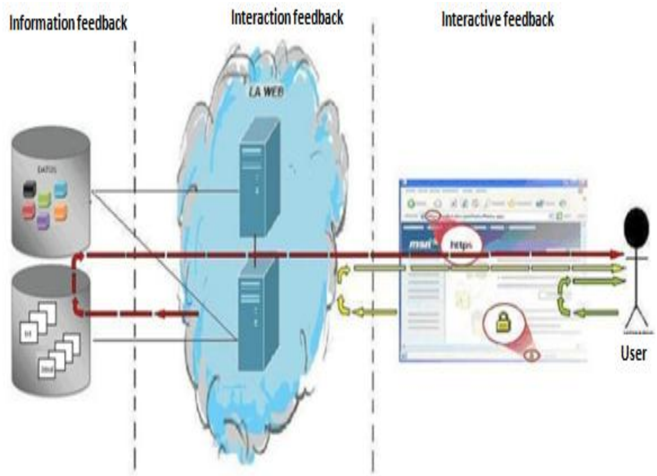


Figure 1. Visual feedback levels in a website.

A website could be considered as a kind of interactive system. The term visual feedback in an interactive system is applied to any graphic form of communication from the system towards the user [9]. Visual, auditory and kinesthetic are different kind of feedbacks that could be used by the system in order offer an easy, comprehensible and usable way to perform user tasks. Visual feedback is predominant in current interactive systems; it can come from different sources in a website. This feedback can be classified in three different categories as in [9]: *information*, *interaction* and *interactivity* levels (see Figure 1). The first category of visual feedback displays the status and the digital content stored in the system. The interaction feedback shows the state of services as available/unavailable. Finally, the interactive feedback is notified immediately to the user with information related to the management of input and output devices used by the user to perform his task. Note that different feedbacks could be closely related, for instance a bank transfer requires multiple visual feedbacks with information about the client's account and details of the service given to the user.

Since visual feedback is predominant in current websites, we consider that the visual feedback could be a meaningful mean to provide security information and to improve security and productivity for a user task. This paper proposes a set of best practices to assist the user about the security features in a website using visual feedback. For this purpose, this article shows in section two a more detailed analysis of the problem. In section three, we propose a solution in terms of a classification of interaction patterns [5][6] to design the visual feedback to assist the users to make their tasks to be carried out securely. Section four describes several examples of the interaction design patterns proposed in previous sections. Before the conclusion, section five discuses some related work.

II. OUTLINE OF THE PROBLEM

A user could lose control when an online service is requested, for example the exchange of personal data, purchasing and payment of electronic products, or downloading files via Internet banking. Even if users request the services of a website, they may consider it an insecure system, and therefore certain actions generate mistrust and doubt, and even more so when the user is unaware of what security measures are provided by the websites.

When the user interacts with a website, he expects that the GUI gives answers to any of his questions, such as: *What is happening in the system?, why this object is displayed on the screen?, Where am I? And what I can do?*. But how to give a user visual feedback on the security measures of websites?. A good feedback would allow the user to prevent or correct an error caused by a malicious attack.

During the design and development of usability and security aspects for a website we need to take into account:

- Usability aspects are frequently treated in isolation of security aspects [4].
- Taking into account usability and security is considered as a tradeoff for the development team [1].
- It is necessary to use some specification techniques in order to deal with different abstraction levels and diverse perspectives [3].
- In general, formal specification techniques do not address the issues of erroneous behavior of an interactive system, which may have serious consequences for the system and user tasks [2].
- The usage of security aspects is frequently ambiguous for the user. Therefore, the user needs guidance to apply such aspects.

The next sections describe some solutions to the aforementioned problems.

III. INTERACTION PATTERNS FOR DESIGNING VISUAL FEEDBACK

It is quite difficult to develop the external aspect of a system without being immediately stuck into the inherent relation with the internal aspects of system. Taking into account the external aspect during the development of interactive system, it is necessary to work with the presentation, as well as the internal function of system. In addition, a reliable interactive system is not useful for a final user if it is not easy to use, then the security and usability are two significant characteristics in an interactive system. For example the usability flaws of identity management are complex, the structural part require careful thought and redesign of entire systems and standards to fix, but some of these aspects are closely related to a well-designed UI. We point the lack of tools that help identity management systems' developers to mitigate most of the design-challenges particularly those certainly related to the design process of UI's.

It is very important that visual feedback should be displayed through a well-designed user interface. For this goal, current work propose the use of interaction design patterns [5][6], they represent a solution given a recurring problem designing a GUI within a specific context. In addition, the specification of a pattern can communicate the experience and knowledge in a certain domain [5][7].

A good alternative to generating a well designed of security feedback consists of applying interactive design patterns, because it is well known that a pattern represents a proven solution for a recurrent problem within a certain environment. From a computer science perspective, Human-Computer Interaction (HCI) deals with the interaction between one or more users and one or more computers using the GUI of a program [9]. The concepts of traditional HCI can be used to design the interface or improve some interface currently available, considering aspects such as usability. Usability determines the ease of use of a specific technology, the level of effectiveness of the technology, and the satisfaction of the user with the results obtained by using a specific technology to perform specific tasks [9].The interaction design patterns proposed here are classified according to three categories of visual feedback offered by a website.

Informative feedback category: Here is included all information to notify users about available security features, the correct way to use these features, detection of malicious attacks and the internal status of the system.

Interaction feedback category: This category brings together the interaction forms useful to establish the navigation in the windows' interface. In the same way are included the communication forms for the enable or disable of security features, and also, interaction forms to present suggestions of actions to follow when some threat is detected.

Interaction feedback category: This category includes the interactive patterns to specify the security feedback needed to convey information to the end user when the elements of the interface are handled by means of mouse or keyboard.

The interactive patterns of three previous categories form a pattern language (see Table 1); they could be applied to solve the security issues according to the linguistic nature of dialog between the user and an interactive system.

TABLE 1. CLASSIFICATION OF INTERACTIVE PATTERNS

Interaction design patterns for Secure Website	**Informative feedback**	Guessing login
		Accurate Information
		State of secure website
		Protection of personal data
	Interaction feedback	Identification of secure websites
		Restriction of websites for adults
		Activation of online services
	Interactive feedback	Contextual secure feedback.
		Secure website with icons
		Warning with input devices pointer

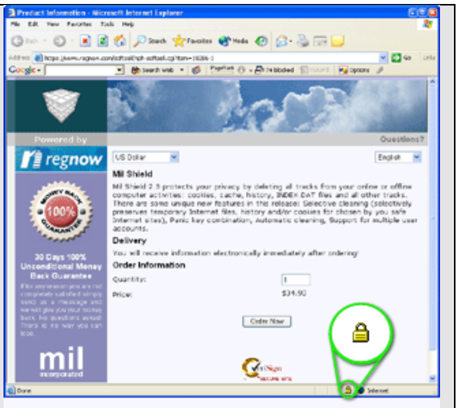
The collection of interaction patterns for secure websites is not exhaustive, someone interested in security and usability aspects could update with new interaction patterns. One of the objective, it is to offer to designer a high level description of visual feedback of different software modules of an interactive system independent of any graphical environment.

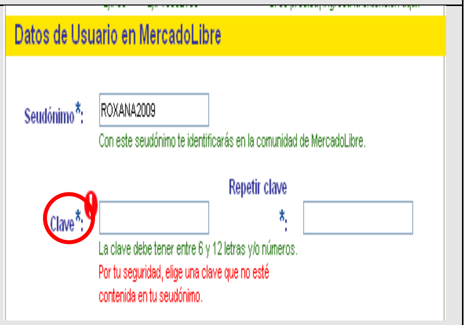
IV. APPLICATION OF INTERACTIVE PATTERNS

This section describes in detail every category of interaction design patterns proposed in Table 1.

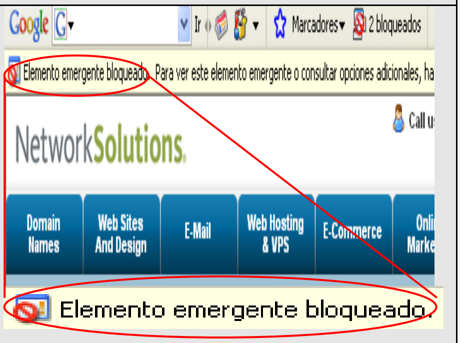
A. *Information Feedback*

This group of interaction design patterns describes some solutions to display the information in a secure manner. Thus, the designer could offer some guidelines to design visualize the status of security system through preventive or warning messages, it is important to specify that user can decide whether cancel or continue an operation at any moment of interaction. Several component of a GUI could be used, for example a preventive messages, an action buttons and/or give some links with more detailed information.

Name	Accurate information
Problem	User doesn’t know if the information obtained from a website is secure.
Context	When user require private information provided by a website.
Force	Provide secure facilitates to get information provided by a website.
Solution	With the information required by user, display some security certificate or icons as part of graphical UI.
Example	 Product Information - Microsoft Internet Explorer File Edit View Favorites Tools Help Back Search Favorites Media Address https://www.regnow.com/softsell/nph-softsell.cgi?item=10206-1 Go Links Google Search web PageRank blocked AutoFill Options Powered by regnow Questions? US Dollar English MONEY BACK 100% GUARANTEE mil incorporated VeriSign Secured site Done Internet Mil Shield Mil Shield 2.3 protects your privacy by deleting all tracks from your online or offline computer activities: cookies, cache, history, INDEX DAT files and all other tracks. There are some unique new features in this release: Selective cleaning (selectively preserves temporary Internet files, history and/or cookies for chosen by you safe Internet sites), Panic key combination, Automatic cleaning, Support for multiple user accounts. Delivery You will receive information electronically immediately after ordering! Order Information Quantity: 1 Price: $34.90 Order Now 30 Days 100% Unconditional Money Back Guarantee If for any reason you are not completely satisfied simply send us a message and we will give you your money back. No questions asked! There is no way you can lose. In this example we can see the contents of a e-commerce website by a secure channel of communication. A padlock icon is showed within the GUI.
Consequence	Properly security symbols used in a website make feel user secure about the authenticity of the received information.

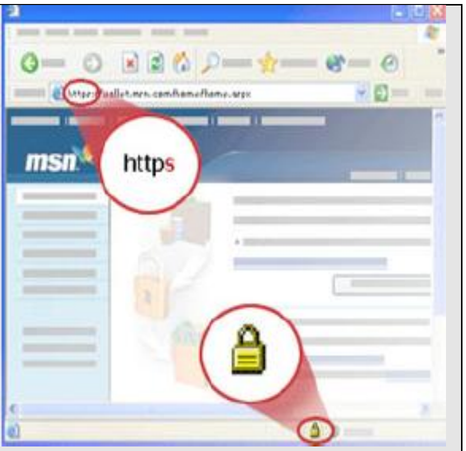
Name	Guessing login
Problem	User require a new password to access new services
Context	When a user creates a new account on a website.
Usability Principle	The system could help user tasks to be developed in a secure manner
Solution	If the key provided by user is vulnerable to attack, website should alert and advise the user to change the password.
Example	 Datos de Usuario en MercadoLibre Seudónimo*: ROXANA2009 Con este seudónimo te identificarás en la comunidad de MercadoLibre. Clave*: Repetir clave *: La clave debe tener entre 6 y 12 letras y/o números. Por tu seguridad, elige una clave que no esté contenida en tu seudónimo. Visual feedback of a e-commerce website where the user find advises for getting valid keys in order to create a shopping list online.
Consequence	Give facilities for a better comprehension of user task

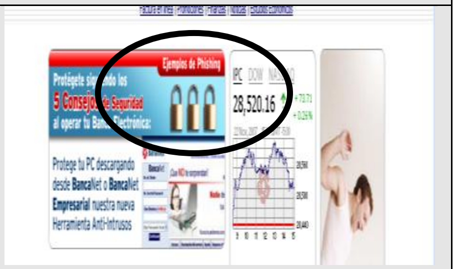
Name	Blocking of malicious access
Problem	A website displays a security message but they are specified in terms of internal

	operations.
Context	A secured website should maintain communication with user to set out the actions that the system exerts on the basis of their safety
Force	Display information explicitly to users about current security state of website
Solution	Report clearly and simply the user about processes running the system internally to maintain their security, whether through images, text messages or sounds
Example	 Elemento emergente bloqueado. Para ver este elemento emergente o consultar opciones adicionales, ha Google Marcadores 2 bloqueados NetworkSolutions Call u Domain Names Web Sites And Design E-Mail Web Hosting & VPS E-Commerce Onli Marke Elemento emergente bloqueado The browser has blocked some facilities of website site in order to protect user task, giving information about the option to activate such facility,.
Consequence	User feels protected by the system.

B. *Interaction Feedback*

The objective of this kind of feedback is display the evolution of communication state between the user and system. This category also includes feedback to the user through the navigation between application windows and the activation of buttons and/or menus for display valid actions.

Name	**Identification of secure websites.**
Problem	User doesn't have any information about the security of current website.
Context	Confidential websites that provide safety information and service online
Force	Notify the security provided by the site
Solution	Show clearly and non confusing information about different security mechanisms provided of current web.
Example	 In this example we can see how the interface is notified by using a secure (https) protocol http. With the lock is notified of the secure connection using SSL certificates.
Consequence	Access to secure online services

Name	**Navigation on limited areas**
Problem	User feel insecure every time navigate on Internet with reduced space.
Context	Website where the safety information required offering deployed in large quantities and screen space is limited for example in mobile devices.
Force	Help the user to reinforce the security of a website
Solution	Allow the user to view information in several logical drives such as windows, dialog boxes, lists etc deployment., In order to facilitate the exploration of safety information either through direct or sequential navigation
Example	 Ejemplos de Phishing 5 Consejos de Seguridad 28,520.16 The example shows how a website helps the user with a dialog box, it make easy to identify and activate secure online services.
Consequence	Navigation is better and allows user a better access to the content of website.

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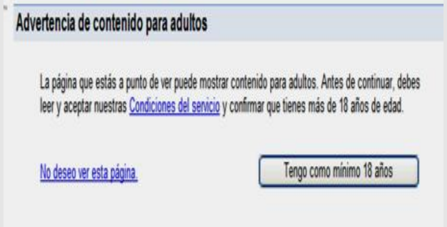
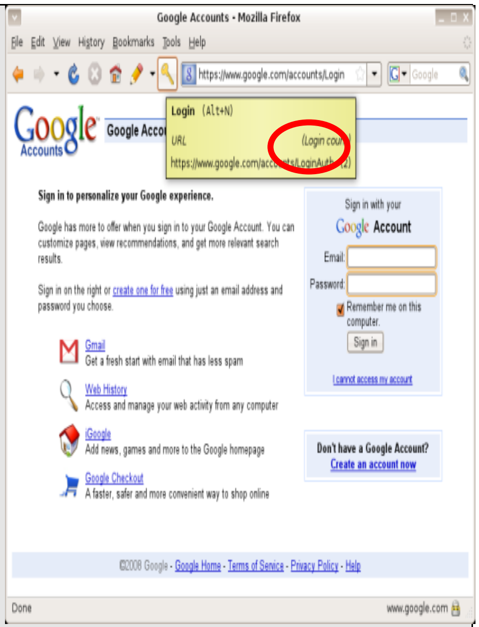
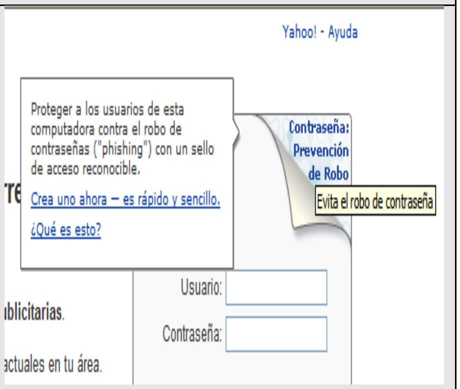
Name	Restriction of websites for adults
Problem	How does user prevent to access a website with inappropriate content?
Context	Parental control in order to avoid lose control of kid access of website
Force	User protection.
Solution	Use a warning message (before entering the site) to notify inappropriate content. In case of adult users give the opportunity decide whether cancel or continue to access website.
Example	 Advertencia de contenido para adultos La página que estás a punto de ver puede mostrar contenido para adultos. Antes de continuar, debes leer y aceptar nuestras Condiciones del servicio y confirmar que tienes más de 18 años de edad. No deseo ver esta página Tengo como mínimo 18 años This message informs user is trying to enter a website properly for adult. Note that the message gives the opportunity to enter next web page.
Consequence	Share the responsibilities with the system

C. *Interactive Feedback*

Graphical user interfaces of current website increasingly adopt a direct-manipulation style of interaction [8], they give the end user the illusion of directly acting on the objects of interest rather than indirectly accessing them through command buttons and data-entry widgets. Direct manipulation style require immediate feedback and contextual feedback, the management of these feedbacks calls for a much finer grained dialogue modeling than is required for conventional indirect manipulation interfaces. These best practices are taken into account to solve some security issues of website and they are encapsulated in the interactive design patterns.

Name	Secure website with icons
Problem	Lack of secure information about user actions
Context	When user action is affected by security issues
Force	Provide safety facilities through user actions.
Solution	Use icons and mouse pointer to describe the confidentiality of information or services online. This feedback is shown when the mouse pointer passes over the item of interest to user and could disappear out of icon.
Example	 Google Accounts - Mozilla Firefox File Edit View History Bookmarks Tools Help https://www.google.com/accounts/Login Login (Alt+N) URL (Login cou https://www.google.com/acc...ts/LoginAuth (2) Google Accounts Sign in to personalize your Google experience. Google has more to offer when you sign in to your Google Account. You can customize pages, view recommendations, and get more relevant search results. Sign in on the right or create one for free using just an email address and password you choose. Gmail Get a fresh start with email that has less spam Web History Access and manage your web activity from any computer iGoogle Add news, games and more to the Google homepage Google Checkout A faster, safer and more convenient way to shop online Sign in with your Google Account Email: Password: ☑ Remember me on this computer. Sign in I cannot access my account Don't have a Google Account? Create an account now ©2008 Google - Google Home - Terms of Service - Privacy Policy - Help Done www.google.com Here, the visual feedback provides information about the definition of password when user passes the mouse pointer over the icon with a key.
Consequence	User actions allow learning about solution of security issues in a website.

Name	Contextual secure feedback.
Problem	User doesn't have detailed security information in a website
Context	In sensitive text or transactions that provide safety information to user
Force	Use direct interaction style to solve security issues.
Solution	Show security capsules in a website when the user pass the pointer over a meaningful text or objects of a UI.
Example	 Yahoo! - Ayuda Proteger a los usuarios de esta computadora contra el robo de contraseñas ("phishing") con un sello de acceso reconocible. Crea uno ahora – es rápido y sencillo. ¿Qué es esto? Contraseña: Prevención de Robo Evita el robo de contraseña Usuario: Contraseña: ıblicitarias. ıctuales en tu área. In the above example the user informed about preventing password theft through the deployment of information when the

	user passes the mouse pointer over the object composing UI.
Consequence	The user will be informed through their own actions on the site.

V DISCUSSION

In the literature of security engineering [12], several works have been proposed a large number of security patterns regrouped in catalogue [10] [11]. These catalogues cover several aspects of security in order to build reliable software, but visual feedback is not taken into account. Braz et al. [1] have started to take into account the usability with secure factors. In a similar way, current work make emphasis in the visual feedback as a mean at design level for a better understand and comprehension of security issues of a web site. The contribution consists of a set of design patterns to design usable information security feedback combining the concept of user interface patterns [6] and security patterns [10].

VI. CONCLUSIONS AND FUTURE WORKS

This paper proposed a collection of interaction patterns as a specification technique for designing feedback for secure websites with a particular emphasis on visual feedback. The visual feedback can come from different sources in a website to assure the user's task: The first category of visual feedback of information is the group of security patterns that describe in a coherent and continuous way the state in which the user will find the website or any of its internal processes required in a transaction. Visual feedback at the level of user interaction indicates the state of services as available or unavailable to him. The interactive visual feedback captures best practices to assure user actions in detail.

Finally, several aspects could be considered as future work, one of them is the specification of interaction design patterns based on different kinds of feedback such as visual, auditory and kinesthetic.

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REFERENCES

[1] B. Christina, S. Ahmed, and M. David, Designing a Trade-off between Usability and Security: A Metrics Based-Model. Proc. of 11th IFIP TC 13 Conf. on Human-Computer Interaction INTERACT'2007. LNCS Springer, vol. 4663, 2007, pp 114–126.

[2] R. Robert, K. Claire Marie, K. Jhon, and B. Carolyn, Usability Challenges in Security and Privacy Policy-Authoring Interfaces. In: Proc. of 11th IFIP TC 13 Conf. on Human-Computer Interaction INTERACT'2007. LNCS Springer, vol. 4663, 2007, pp. 141–155.

[3] R. Jennifer, J. Carolina, D. Paul, S. Roberto, and N. Kari, G. David, R. Jie, D. Paul, and R. David, Seeing Further: Extending Visualization as a Basis for Usable Security. Proc. of 2nd ACM Symposium on Usable Privacy and Security, SOUPS'2006 ACM Press, 2006, pp. 145–155

[4] V. Roth and T. Turner, User Studies on Security: Good vs. Perfect. In: Proc. of ACM CHI'2007, Workshop on Security User Studies, 2007.

[5] B. Sergy, F. Peter, and Y. Anatoli, User Interface Design Patterns for Interactive Modeling. DVS-IS 2002, LNCS 2545, 2002, pp. 148-158.

[6] V. Martijn and H. Trćtteberg, Interaction Patterns in User Interfaces. Proc. Seventh Pattern Languages of Programs Conference, PLOP 2000.

[7] G. Erich, H. Richard, J. Ralph, and V. Johnson, Design Patterns : Elements of Reusable Object-Oriented Software, Addison-Wesley Professional Computing, 1995.

[8] S. Ben and P.Cathrine, Designing the User Interface: strategies for effective human-computer interaction, Addison-Wesley, 1987. Fourth edition with Catherine Plaisant as co-author 2004, ISBN 0-321-26978-0.

[9] D. Alan, F. Janet, A. Gregory, and B. Russell, Human-Computer Interaction. Prentice Hall, 2004. ISBN 0-13-046109-1

[10] S. Marcus, F. Eduardo, H. Duane, B. Frank, and S. Peter, Security Patterns: integrating security and systems engineering. John Wiley and Sons, 2005.

[11] M. Hafiz, A. Paul, and J. Ralph, Organizing security patterns. IEEE Software, vol 24, 2007, pp. 52-60.

[12] S. Markus, Security Engineering with Patterns: Origins Theoretical Models, and New Applications Editorial Springer ; 2003, LNCS275, ISBN-10: 3540407316