SyC - Show your Card

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Abstract: How many citizens own a smart card or barcode reader? A few. How many own a webcam? A lot. So why don't we use a webcam to digitally identify a citizen that would like to enter your egov service site? The City of Turin designed SyC Show Your Card, a system that let people, optionally, use their own webcam to identify themselves as a result of a piece of software that reads a 2D barcode identifier printed on the Torinofacile card through the webcam. Users only have to type their password, and they are easily identified by the local egov portal.

Keywords: webcam, two-dimensional barcode, Data Matrix, security

1. Introduction

How many smart card readers are currently installed in personal computers? Surely less than the number of webcams, a simple device that is more and more widespread among citizens.

This is the main consideration that led to the idea of using a webcam to acquire a complex code at once and send it over the Internet. Through a webcam and a very simple software interface it is possible to read a code printed on a card or ticket and to send it to an application that will process it.

This idea has been initially implemented to provide Torinofacile users with a new way to identify themselves within the portal. Until the implementation of this new facility, the identification process required registered users to type a personal alphanumeric code, plus username and password, in a three fields form. The identification process is secure enough due to the fact that it is based on three different keys. But at the same time it forces the user to remember all these three keys and input them correctly.

Now users have also another way. In fact their credential printed on a card has been converted also in a two-dimensional barcode that the user can show to a webcam activated by a simple flash interface inside an HTML page. As soon as the code is acquired and decoded, the data are sent to the authentication system in order to complete the identification process asking the user only his/her password.

2. Objectives

This project started in mid 2007 to provide citizens with a new simple way to login on the Turin portal using a webcam. Of course this is not a new authentication system, but it is only a new way to acquire a personal identification code without having to type it. The idea was born from the consideration that nobody reads a two-dimensional barcode through a webcam to identify users until now, and moreover, the uses of this technology, are endless, because this system could be used to simplify access, for instance, to pay personal services normally identified by a long string of characters, preventing typing errors and giving more accuracy to the whole system. So, we think this is a very new and creative use of a known system.

Since 2000, the Turin Municipality has been pursuing the goal to create online services to let users access personalized information or to send administrative request to the City

Department. To protect citizen privacy, this communication channel had to be provided with an authentication system for the identification.

This had to follow some simple but strategic requirements:

- Low hardware requirements.
- Easy to use.
- On line registration process
- Secure
- Consistent with the choices made nationally on the Electronic Identity Card
- Last but not least, cheap for the Municipality and free for the citizen.

This goal was achieved through the creation of Torinofacile system [1], a portal where it is possible to find every municipal service available on-line and where a citizen can register and acquire an individual digital identity to spend on the portal to be securely identified. The digital identity is mainly set up by two elements:

1. A username and a password chosen by the user
2. A Personal Identification Code given by the system and printed on a simple free paper based card, called Torinofacile card.

To identify himself within the system the citizen has to provide both the credentials. Currently about 30.000 users are already registered on Torinofacile portal, of which more than 6000 are professional who use on-line services daily to exchange personalized information with the local Public Administration.

The same approach was used by many other Municipalities participating in the regional Government plan, led by the City of Turin, in order to share good practices. From the point of view of the city this was just the starting point to begin developing new online services, in an easy digital environment. This is the context in which Turin Municipality decided to provide the citizen with a new facility, together with other form based methods, to easily access its online services.

3. Methodology

It was clear from the very beginning of the project that SyC system had a small dimension, that the requirements were not all identified at once and that they could change during the development phase. Besides the project should have had a very low cost and should have been realized by a team of developers inside the Municipality. For these reasons the City of Turin decided to follow a development approach very similar to the Rapid Application Development (RAD) methodology, instead of using a more articulated multi-phase methodology.

The chosen approach allowed the team to create a set of prototypes implementing incrementally the needed functionalities.

The design and development of the system was carried on by a team of three developers, each one focused on a different component of the system. Once the first fully functional release of the system was realized it was not possible to open to the citizens the new service, because simply they did not own a card with the two-dimensional barcode representing their personal code.

It had been decided then to activate a test phase. Before accessing the test, users were asked to login, through the standard form based approach, and then to request a run-time service allowing them to download and print a PDF file containing the two-dimensional barcode representation of their personal alphanumeric code. This way users were able to test the new login feature, without having to type the personal code.

At the end of the test, citizens were asked to answer a short survey about the use of SyC system, focusing on the difficulties and problems they might have found. This prompt

feedback allowed the developers' team to continuously improve the usability and efficiency of the system during the test phase.

Once the test phase ended, the SyC system has been made available to all users on the Torinofacile portal and at the same time the Torinofacile card issuing process has been modified in order to print on the card the user's personal code represented in the two-dimensional barcode image.

4. Technology Description

The SyC system uses three distinct technological components:
- The Data Matrix coding and decoding component, called codec.
- The user interface and webcam controller
- The authentication system interface

Figure 1: The webcam flash interface with positive response

The codec is a Java Servlet with an XML interface that provides the coding and decoding service of Data Matrix code. A Data Matrix code is a two-dimensional matrix barcode consisting of black and white square modules arranged in either a square or rectangular pattern. The information to be encoded can be text or raw data. Usual data size ranges from a few bytes up to 2 kilobytes. The length of the encoded data depends on the symbol dimension used. Error correction codes are added to increase symbol strength: even if they are partially damaged, they can still be read. A Data Matrix symbol can store up to 2,335 alphanumeric characters.

This component is used in two distinct phases of the overall identification process. At the end of the citizen registration, when the Torinofacile card is printed out, the codec component is called by the printing system via an HTTP post sending the string containing the user's personal code plus an MD5 hashing, as control code. The codec works out the string and returns the image stream with the two-dimensional barcode.

The codec is used again during the user identification process, when it receives the image stream got by the webcam. If the decoding ends successfully it returns a positive answer with the text string decoded, otherwise it returns an error message.

The second component of the system is a flash application that provides the user interface and permits to take pictures from the webcam. Once the webcam is activated and a single picture is captured, the flash application sends the image to the decoding service and waits for the answer. In case of positive answer it forwards the user browser towards the authentication system posting the decoded string. Otherwise, if the answer is negative, it prompts the user to get a new shot from the webcam.

The third and last component is the authentication system interface hosted by the Torinofacile portal. The interface receives the string, verifies its validity working out the hashing code and extracts the personal data. If the string is valid, the user is asked to type username and password - the only data that he is asked to type - and then all these information are sent to the authentication system in order to be validated.

5. Developments

The architecture design follows two main principles:

- Service Oriented principle, governing aspects of communication, architecture and processing logic as loose coupling, abstraction, composability, autonomy, statelessness.
- Software reusability that is in part driven by the previous one, and it is at the base of all the cooperation projects realized in the Piedmont Region in the latest years.
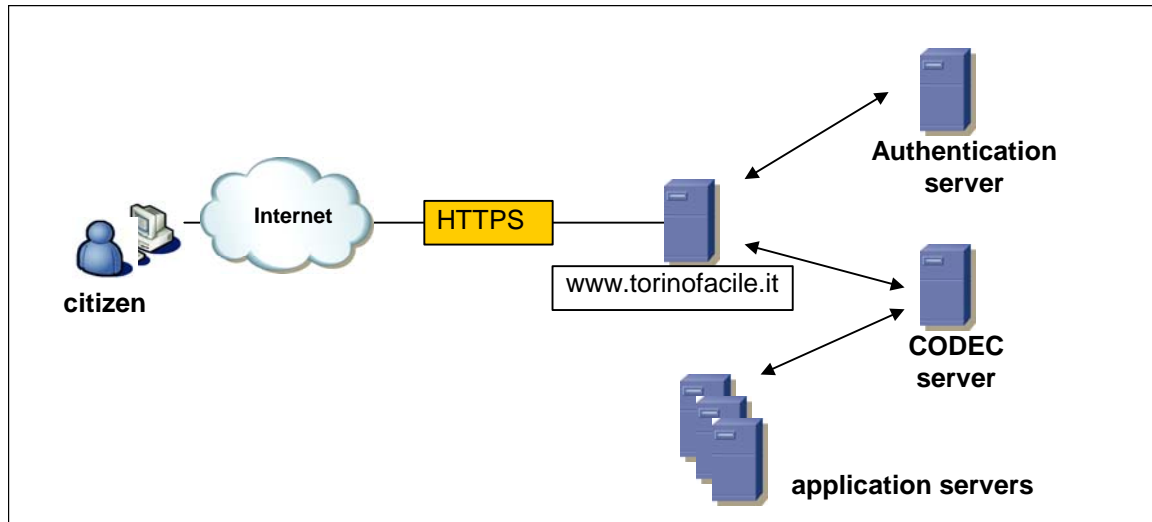

Figure 2:The SyC architecture

The three components previously described have a life cycle completely independent from each other, with defined interfaces. Whenever is needed it is possible to improve a component or change it with a different one, without having to modify the other components. This potentiality has been used during the test phase and the start-up period: first the user interface has been changed in order to make it more usable and improve the interaction between the citizen ant the webcam; then the codec has been changed to make the system more efficient. All these changes have been developed at the same time, without modifying the interfaces and the new versions could run in parallel so to permit the switch from one release to another without stopping the service.

Besides each component can be reused in other contexts. For example the City of Turin has already started to work on a new codec, with the aim to add other two-dimensional barcode algorithms to be used not only by on-line services, but also by back-office applications using standard barcode readers. In this case on-line services that need to add a two-dimensional barcode images, for example in an on-line generated document, can invoke the codec with the appropriate parameters identifying the needed barcode. On the other side a back-office application can read a large amount of data stored in the barcode without having to retype them.

6. Results

Today there are about one hundred citizens that have been using SyC to login on the Torinofacile portal and there are daily requests for new cards having the code printed, since the old cards do not have it.

The use of the two-dimensional barcode to identify oneself in the portal has not implied a decrease of the time needed to log in. Nevertheless it has been chosen in those cases where the user had some difficulties typing correctly his personal code, following the right sequence of the alphanumeric characters. In fact, when the user becomes familiar with the interaction with SyC, the chance of mistakes is null and the time spent showing the code to

the webcam is comparable to the average time required to type it more than once due to mistakes, or to the extra effort needed to avoid them.

6.1 Security issues

It is important to state that the use of this new identification process did not cause a drop in the security level of the authentication system. In relation to this aspect it is worth detailing some specific and critical security issues that have been taken into consideration when implementing SyC. For each point a possible weakness is reported and the solution adopted is described.

1. The barcode image is printed on the card and so it can be photocopied. Of course this is true, but this is valid in general for all the data printed in clear text on the Torinofacile card, as required by the cheap solution adopted in Turin. For this reason it is important that the citizen keeps the card safe, as he does with a credit card. Nevertheless it needs to be highlighted that the barcode cannot be read with a human eye and in this way it is more secure than have it in clear text on the card.
2. The barcode can be generated on its own using some available tool knowing the text string to be coded. The real barcode is generated using a text string, representing the user personal code, and a non reversible hashing string created from the string plus a private passphrase. The interface towards the authentication system verifies the integrity and the authenticity of the hashing before accepting the decoded data, preventing possible misuse.
3. The data sent to the codec are transmitted in plain text over the communication channel. This data cannot be read by a third party, because the channel uses SSL encryption. In fact all the communications between the citizen browser and authentication system, codec included, use the secure protocol SSL and the standard X509v3.

7. Business Benefits

There are two main aspects about the SyC project that should be spread because they are beyond the state-of-the-art. The first is the use of a webcam to acquire information data. Till today this device has been used to send images over the Internet to another person without considering the meaning of the images transmitted, but now it is used as a reader device in order to acquire a specific image and decode it to gather data.

The second one is the use of two-dimensional barcode inside the Public Administration in Italy. Turin is the first city that decided to use this coding to represent data as many other private companies already do. Surely the combination of these two technologies is something new and tries to bring on the Internet what phone companies tried to do with some specific software installed on video cell phone.

Of course citizens that use this new method do not save money and they do not save time, but simply they do not have to type their personal code. This implies that the probability of mistakes is considerably reduced. So you can imagine which could be the advantage for a citizen to show a ticket with a code instead of typing it when it is more than 10 characters, like fine identification code, or 18 characters as used in bank and postal payment to identify transactions.

8. Conclusions

We can say that the Municipality of Turin has learnt three main lessons from this project.

The first is that it is possible to use a webcam as a card reader. In fact the software component, able to acquire an image and send it to an on-line application, is quite general and reusable. This allows thinking to other possible uses of this device.

The second lesson is related to the 2D barcode encoding used. The project SyC adopted the DataMatrix encoding, developing simple API to encode and decode data, and other

encoding algorithms, like PDF417, are being developed to use them in similar contexts where a Public Administration has the need of reading in a fast way up to 800 characters.

The third and last lesson is that citizens are ready to communicate with a Public Administration in a new way using a widely available device. This case was born exactly to bring what people already did in the offline world into the online channel. In fact in real life there are many and many examples where a code is read and sent to an electronic application. But what about on-line services? And what about using common devices?

Besides we can say that SyC addresses only the online channel, but the system has been implemented bearing in mind other offline use cases and in the future Turin Municipality will use the system also to recognize people and acquire their identification data at a public counter or it will gather the id reference number of a document from a two-dimensional barcode without having to type it.

References

[1] Torinofacile. www.torinofacile.it