A Location Based Service for the production of interactive photographs

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Abstract: Currently, photographs are an indispensable means for documenting and surveying objects and places, however, they have an inherent limitation due to a lack of identification data. Digital applications on a photograph could resolve this limitation. This paper, therefore, details the results of a research based on an innovative photographic system, with the purpose of identifying objects in digital photos. To carry out this procedure, this is achieved by partly utilizing a Location Based Service. The final product, obtained from the user in real time with a simple shot of the photo, constitutes a small information system, which enables the analysis of the images of places and objects in an interactive way, and their association to related information. Furthermore, it enables additional functions, such as the connection of individual objects to websites for further and more in depth analysis; framing of objects; research of objects or categories of objects within photographic archives, highlighting the result within the image.

The described system is currently subject to patent application.

Keywords: interactive photograph, digital image, Location Based Service, identification of objects, data management.

Introduction

The result of a photographic shot is an image that, in a digital format, describes the objects through areas of colour, the pixels, arranged in a matrix. It consists therefore of a representation of which its limitation is its incapacity to provide the identification data. In fact, the information regarding the identity of photographed places and objects are independent from the image taken and are acquired at a different time. The attribution can be done through a mental or automatic recognition. In the first case, the user compares the taken image and the representation from his/her cultural education; if no corresponding one is found, then he/she can consult archives of images, descriptions, or if possible, verify directly on site. The automatic recognition functions through algorithms which are typical of the computer vision; usually it functions through a correlation between images, that is between the image to be interpreted and a collection of designs and images, taking as a point of reference colour and structural schemes. It is a complex operation, which would be more easily carried out with reference to the category to which the object belongs (for example: building), rather than its identity (for example: "Procuratie Vecchie-Venezia").

However, in both the mental recognition and the automatic one, sometimes it can be difficult to carry out a specific association, due to a lack of characteristic elements. To give an example, the identification of suburban territories, where there aren't any distinguishable aspects.

The research described in this paper aims to offer a contribution to the solution of the problem, through a methodology that, unequivocally and also even without referring aspects, could provide an association between the objects and their identification. This is nowadays feasible thanks to the development of instruments, that aim to integrate the different media, and the introduction in the amateur market of technologies which until recently were only limited to specialist use. For example, mobile telephones integrated with digital cameras, with GPS (Global Positioning System) devices and with image sensors, the resolutions of which, are getting closer to those of video cameras; the possibility of transmitting information from a distance through a mobile telephone network or the internet; the possibility to utilise servers dedicated to a specific service, and related to the location of the user. In general, the application of this new technology to the photograph aims more to increase the automation of the functions than to innovate the type of functions themselves. On the other hand that it is now the time for a different and more articulated fruition of images, which could revolutionise their use and create an added value for the photos. After the big innovation introduced by the transition from the analogue photos to the digital ones, this added value can be constituted by the

transition from digital photos *tout court* to the digital photos as an alternative information system in miniature. Every photo constitutes a little interactive independent universe, where the image becomes the pretext and the support for the proliferation of data connected to individual objects, data which can be increased and integrated by the user.

The invention of this new type of photo which will subsequently be named interactive photo, has been the object of the research conducted by the author of this paper. This research has produced as a result the formulation of how to realize and manage an innovative photographic system.

The System

The photographic system capable of producing interactive photos allows for two different ways of functioning; the first one by which all the procedure of the formation of the image is realized through a portable user device, the other one which requests also the availability of a specialised server, connected to the devise during the taking of the photo via a mobile telephone network or via mobile internet. The server conducts part of the procedure in a Location Based Service mode, lightening the user software devise, in the memory and in the operating system. This second form of realization will now only be considered.

The system could be preferably utilized for outside recording. It allows in particular:

- that the information on the identity of the photographed objects are recorded in the photo contemporaneously with the photographic shot and are permanently connected to the individual objects in the image;

- that the possibilities of utilizing a photo are strengthened with the following functions:

. interactive consultation functions;

. connection to dedicated internet pages, selecting the image of individual objects;

. research of specific objects and/or categories within the archives of images highlighting the identified objects within the area of the image.

This paper now describes the proposed photographic system, limited to its main functions, detailed in the following points: Location Based Services; hardware and software configuration; and product.

Location Based Service

A Location Based Service (LBS) is a service provided by a server based on the localization of the mobile device requesting it, utilizing a mobile network connection to transmit the data. The aims can be various: entertainment, business, work, research, advertising, alerts, etc. '*The most obvious question is to know where the user himself is with respect to somebody or something else (locating). Users may search for persons, objects or events (searching) and they ask for the way to a location (navigating). Other questions ask for properties of a location (identifying) or they would try to look for events at or nearby a certain location (checking).*' (Steiniger & others, 2006).

In addition to the existing ones, the research carried out has created a new possibility of applying an LBS, which is the contribution of the production of interactive photographs.

Compared to other types of LBS, the application for producing interactive photos requests a particular attention to the user locating data, which in the specific case corresponds with the camera locating data.

This makes us exclude the use of positioning techniques such as WLAN (Wireless Local Area Network) stations, active badges or radio beacons, preferring the use of Global Navigation Satellite System (GNSS).

Besides, unless we apply the speedy procedure, which in the current paper won't be discussed, the need to determine the co-ordinates of the camera device goes with the need of determining also the orientation. This means that the knowledge of the position of a point in the space, generally acquired as beginning data to realise a Location Based Service, is substituted by the knowledge of the position of a solid body in the space. This extends the use of the three-dimensional information, which is basically diffused in the representation of the spacial contents displayed on a mobile phone or smart phone, also to the location of the user. In addition to this, the

camera device has its own direction and wideness of observation which determines what is represented. The data related to the user-location, therefore goes beyond the six parameters (coordinates and angles).

These considerations carry with them a further reflection. The geomatics, in these last years, has entered into direct contact with the final user in an enlarged market (GPS car navigation system, GPS anti-theft device, Location Based Service, etc.). This generally regards the applications in which high precision of the localization data has relatively little importance, because the aim is to communicate where we are approximately in a particular road, or to find the nearest restaurant, or to determine a route. In the same way, in the visualisation of the spatial data, the geometrical aspect seems to undertake a secondary role compared to the visual effect.

Until today, therefore, the final user has had little attention to precision. The new use of producing interactive photos can stimulate a new awareness of the user on the performance of the positioning systems and on the quality of the spacial data. In fact the extent of the data error becomes visible in the final product (however functions to correct this effect can be provided as automatic or manual types). This becomes inevitably a stimulation for the geomatics to promote an advancement in the performance in this category of product. A high precision success within the amateur market.

Hardware and Software Configuration

The proposed photographic system consists of a portable user device which includes the following parts:
- means of acquiring digital images:
- means of locating the position and the orientation of the camera device;
- processor;
- memory for the data processing;
- fixed and removable memory for archiving the data;
- wide display touch screen, interface controls, speakers and microphone;
- software for data processing, located in an external server;
- mobile telephone or mobile internet connection system, to connect to a server in Location Based Service mode; the internet connection system will also be necessary in the event of consulting on site a web page connected to an object present in the image.
- software for image visualizing and management.

The means for the positioning must provide three-dimensional co-ordinates, and can be a GNSS device; the orientation can be picked up by an inertial compass.

The system is conceived to guarantee a good interaction, ease of use, and also the effectiveness of visualisation of the photo and data. The above detailed components are intended to be as integrated parts of a multifunctional device, according to the philosophy of smart phones, capable of guaranteeing an efficient use both during the taking of the image and during the internet connection; the photographic function is not a speedy alternative to the specialised camera[1], because of this the lens and the image sensor will have to be of high performance.

This, however, doesn't prevent the implementation of the system on mobile telephones, or, for professional work, on the specialised cameras, once suitably equipped.

Product

The proposed photographic product is obtained at the same time as taking the photograph. The only requirement of the user is the execution of the shot: the subsequent operations are automatically conducted by the system.

At the moment of the shot of the photo, the software which acquires the images in the portable system records a set of data, including the external parameters of the device. The positioning means are always active during the shooting sessions, to guarantee the immediate determination of the coordinates at the moment of taking the image.

The recorded data are then transmitted via a mobile telephone network or via the internet to a specialised server. The server processes data and produces information about the objects, in table

format. The functions and procedures for data processing are not discussed in this paper, as they are confidential, at this time, due to patent application.

Once the data have been processed, the server sends the result to the device, in a format chosen by the user. The format of the data conditions the consultation of the image, that is the degree of interactivity and the use of more or less complex software for viewing and managing the image.

In the devise the interactive image is then formed. Any possible error can be adjusted in an automatic or manual method.

The final product therefore contains:

- the shot of the place surveyed (fig. 1);

- the information to identify the particular objects existing in the place, visualized, for example, through table views which direct towards the corresponding objects (fig. 2);

- the possibility of framing the objects (fig. 3);

- the option to acquire further information through an internet connection by selecting individual objects contained in the image;

- the ability to store and retrieve images through the search of individual items, having as a result the visualisation of the retrieved photo with the highlighted object.

The identifications can be recalled through the position of the cursor (or by touching the screen) on the object and directly connected with its image. In the case of ambiguity in the identification of bordering objects it is possible to visualise their perimeters.

The search for individual items can be conducted by name, category, or type of use. This allows us to catalog photos; to retrieve specific images, reducing consultation time; to organize the display sequence, according to predetermined items.
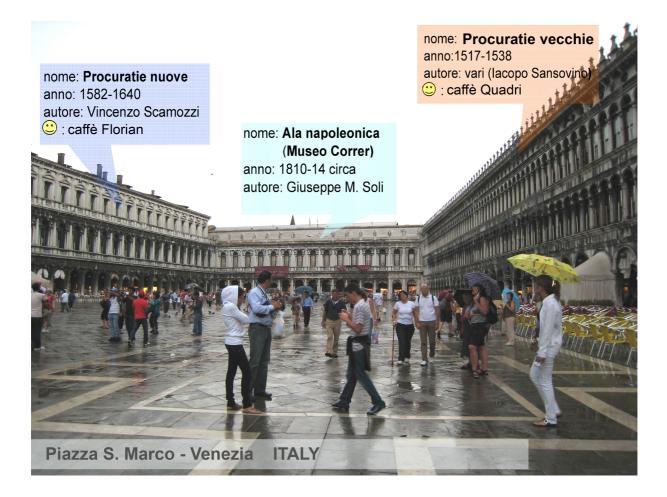

Fig. 1. Photograph

Fig. 2. Photograph with table views

Conclusion

The proposed system constitutes a worthwhile integration between hardware, software and expertises which until recently had limited application: the photographic sector (digital cameras and images) the surveying sector (GNSS), the one of the mobile telephone network, the one of mobile telephones, that of the internet connections (World Wide Web, distance data transmission), that of GIS (Geographical information System). Everything is made easier by the use of Location Based Services, a new element which catalyses the various expertises mentioned above.

The result is the realization of a new type of photograph, with an added value compared to the traditional images. This added value consists of the overcoming of the representation, to obtain, together with it, also the identification of what has been photographed. Together with the above mentioned added value, additional functions are permitted by the organisation of the image itself, like the connection to dedicated internet pages, taken from the image of an object, and the possibility of researching and retrieving specific objects or categories of objects within photographic archives.

The functions described are all applicable at the same time as taking the photographs. Furthermore, they can be applied at a different time, after having downloaded the photos on a computer. This allows us to create archives of images which, even after time, may give to the user data and information on places and objects.

All in all, its about a proper interactive image. Photographs, after years of silence, can now begin to talk.

nome: **Ala napoleonica (museo Correr)**
anno: 1810-14 circa
autore: Giuseppe M. Soli

Piazza S. Marco - Venezia   ITALY

Fig. 3. Photograph with table view and highlighted object.

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Further Information

The described system is currently subject to patent application.
Only some of the functions of the system are described in this paper.

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Note

[1] The necessary hardware is for the major part already available on the market. The following components and functions have already been integrated with mobile telephones: digital cameras, possibility of distance data trasmission and, limited to certain models, also GPS device and more rarely a compass.