Future of Digital Camera in the Home Entertainment Network

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Abstract

Currently, digital cameras are considered as image capture devices for PCs with temporary storage capabilities. Emerging no volatile memories extend this storage capability to thousands snapshots in the camera. On the other hand, digital camera and digital video camera will participate to the Home entertainment network with other electronic consuming appliances such as digital TV receiver, game consoles.. and so on. With this new capabilities, the digital camera will became gradually the permanent storage of the family's snapshot album. Furthermore, snapshots handling will no longer require PC imaging tools. However, current sequential storage do not help the user to efficiently retrieve snapshots from the digital album. In this paper, we propose to use automatic image indexing techniques to quickly select a set of snapshots based on several criteria such as time, geographical position, content, colours, voice annotation...and so on. Moreover, we propose a set a tools for digital TV set and Game console to explore and visualize the digital album with more comfort. The third part of our paper shows how the user can send a set of selected snapshots to a printing provider through his interactive TV set or his wireless phone and get back paper printed snapshots by delivery or at a neighboring photo shop.

Introduction

Electronic photography gain gradually parts of chemical photography market. Current implementations of digital camera are limited by technology constraints (limited storage capacity, and poor exchange capability). However, some new components allow to store more than one gigabyte on a single chip (for example the PLEDM™ technology from Hitachi[3]). Even if we expect only one gigabyte of storage capacity, it will be possible to store thousands snapshots on the family digital camera. Moreover communication capability of digital devices is going to be extended using new wireless technologies like Bluetooth[4] and IrDA.[6] With the new storage capability, we guess that small digital cameras will replace also the traditional family photographic album since users could take their cameras everywhere and could visualize their snapshots on a TV. With the new emerging network technologies, we will observe an increasing communication capability with other digital devices, expanding thus the service scope of digital cameras. In this paper we present two possible architectures around the digital camera. Both of them give a different implementation of the Home Entertainment Environment and exchange possibilities among devices. This paper is structured as follow: Section 1 describes the Home Entertainment Environment and the set of services possibly delivered. Section 2 describes the concept of digital album which not only stores snapshots on the camera but enhance snapshot search and selection. Section 3 and 4 gives a description of the two proposed architecture.

The Home Entertainment Environment

Description

The Home Entertainment Environment (HEE) is composed of wired devices like PCs; Set-Top-Boxes coupled with a TV screen, game stations, DVD players and printers and wireless personal devices like cellular phones and PDAs (see figure 1). The HEE can communicate with a remote environment which is is mainly constituted of remote servers: archival, print, web servers, Image servers or mail servers. Communications among the HEE devices uses classical wired links like USB and serial links, wired LAN networks or more innovative unwired networks like IrDA,[6] and BlueTooth.[4] Communication of HEE devices with outside servers is accomplished using the WAN, phone line with modem or GSM network, cables and satellites.

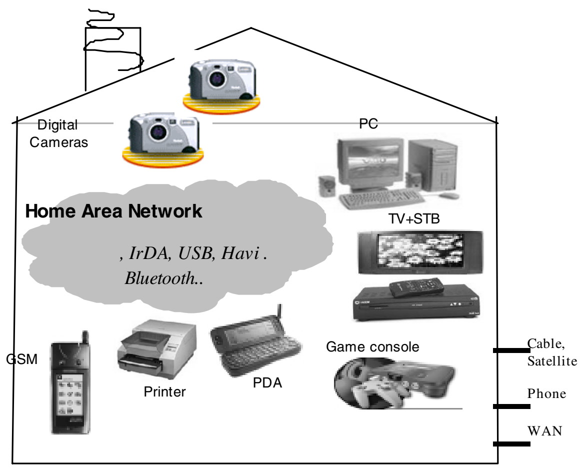

Figure 1. The Home Entertainment Environment

Provided Services

The main services which can be provided in the HEE by the digital camera are:

- ***Snapshots exchange*** between two digital cameras or between the camera and another device of the HEE.
- ***Snapshot printing.*** Snapshots can be printed on a local or a remote professional printer. For the last case, snapshots must be sent first using remote network capabilities.
- ***Camera as Slide show device.*** Camera can contribute to a slide show as a snapshot storage unit: The speaker selects a subset of snapshots, merge them to screen dumps made by a representation-making software like MS-PowerPoint. Using an appropriate camera tool he can play the whole representation by connecting the camera to a video projector or to a TV screen
- ***Image server.*** The camera receives transmission requests from another HEE device or from a remote device. If the requests is trusted, the camera delivers the required set of snapshots.
- ***Snapshot transmission***.The camera owner could send to a professional's web site via the Internet network his snapshots for touch up operations, archival or print purposes. Moreover, the user can send by mail to its friends anywhere in the world all snapshots where they appeared for example.

The Digital Album

With the emerging of the new non-volatile removable memory generation such as the PLED proposed by HITACHI[3] which offers a storage capacity of one gigabyte, several thousands of snapshots can fit simultaneously on the camera's memory. The concept of digital album on the digital camera is from now born. Current digital cameras organise pictures as a sequential list of files (one JPEG image per file) in a removable media (CompactFlash, SmartMedia, Floppy) and files are named by a sequence number (such as IMG001.JPG) or by a time code (such as IMG991004-103127.JPG). The only way to retrieve a picture or to make a selection of a subset of snapshots on the camera manually by the camera user or automatically by a server, is to scan snapshots sequentially. This organisation is not appropriate to visualise thousands snapshots and the user needs other means to retrieve quickly and efficiently a subset of the album. Here in the next section some criteria, which can be retained to classify and then index snapshots.

Storage and Retrieval Criteria

-The snapshot place. Spatiotempotal coordinates are generated by small GPS positioning modules connected to the camera by an USB link. Each snapshot is marked with GPS position and can be sorted and retrieved by geographic coordinates.

-The snapshot date. Snapshots are dated when taken using the camera internal clock or an additional GPS module. The user may retrieve snapshots taken in an with time concepts such as "In the night" or "At Sunset". The user can also retrieve snapshots by events (birthday party, holidays…) retrieved in the user's electronic agenda managed by his PDA.

-The snapshot content. As content criteria we can cite the dominant colours in some areas of the snapshot or the presence of specific shapes (portrait, group of standing persons, building…). But the user can also retrieve in the album snapshots having similarities with a snapshot taken as a reference.

-The keywords extracted from a photographer's comment. Some cameras integrate now an audio input to record vocal comments about a snapshot. The comment is "recognised" with speech recognition software. The sentences can subtitle the snapshot at display time. Moreover, keywords extracted from the sentences are used to retrieve the snapshots.

All these criteria can be combined to refine or to broaden the selection in the album. Several GUI are required to compose criteria in snapshot retrieval in order to fit the device ergonomic (camera 2 inch LCD screen with a 4-kay pad, HDTV screen with remote control pad, PC with a full keyboard and mouse…)

Indexing

To make snapshot selection efficient, indexing information are made when taking the snapshot and will be indexed with, on the camera storage. Indexing information is composed of the GPS coordinates given by the GPS module, the date from the internal clock of the camera, word extracted from the comment of the photographer, color and main shapes information and other information automatically glanned accordingly to the options set when taking the snapshot(colour or N&B, lanscape, …etc). More information on indexing techniques are referenced in [1].

The First Architecture: The HEE Using Java Technologies

We are developing at present, in our laboratory, a prototype including all the functionality listed above. To do so, we choose Java technologies and APIs, first of all for their availability but either for all the positive aspects provided as we assume that Java technologies will be adopted by electronic consuming manufacturers in the two or three future years.

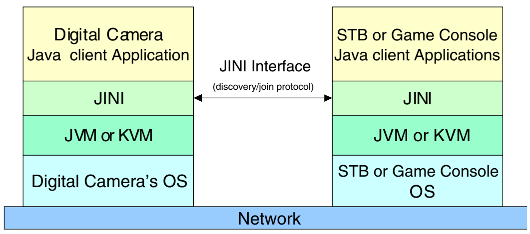

Figure 2. Communication with the JINI technology

As described by figure 2, in this first proposed solution, each device of the HEE should be provided with a JVM for classical devices like PC and servers and KVM for nomadic devices like cellular phone, digital camera and PDA. Each device should support JINI layer[10] to assume interoperability and communication among HEE devices. In fact, JINI technology provides simple mechanisms, which enable devices to form a community.

These devices will be able to communicate together without any planning, installation or human intervention. Furthermore, JINI technology enable to develop distributed applications, without care to the underground physical network technology. A same Java client application has been developed for all devices. The functionality of this application is described in the next section. JINI technology implies three distributed software components: A service locator, the client application and the service. The service locator works like an intermediary between client applications and services. Indeed, services register to a service locator to be used. This is accomplished using the discovery/join protocol. Similarly client application asks for a service via the service locator using the lookup protocol. In both cases, the service locator sends an object called a registrar, which is used as a proxy between the client and the service.

In the HEE we assume that the service locator is affected in a configuration mode on an affected device like the home PC or the STB. This can change in the case of a device crash for example. In this case the second lookup search mode is useful for the application to identify the service locator host. Multicast lookup search mode can be also useful when the user takes its camera outside home environment, for example to its friend's home. The application in this case looks up dynamically for a service locator to reach a specified service.

The Java Client Application

The client application allows user to create and manipulate the digital album using the indexing techniques described in the previous paragraphs. In this application, the digital album is represented by a database in which snapshots are stored with some meta-information allowing multicriteria indexing and retrieval. The research criteria experienced in the prototype are: GPS localisation, time and date when the snapshot is taken, the shape and the type of the snapshot i.e. Black & white or coloured snapshots and vocal indexing using Java Speech (JSAPI).[10] In addition, this application allow synchronisation and exchange. Code size of this application does not exceed 400K and can easily be integrated on small mobile devices.

As devices with these technologies do not yet exist, this architecture has been simulated with PCs each representing a device of the HEE and each running the Java client application. Communication between devices using JINI layer has been successfully validated. More details for this first architecture is given in Ref. 2. At present, we are testing a real communication between a digital camera simulated with a PC and a PalmPilot using IrDA as underground physical communication layer. A similar experience is tested with Psion.device.

The Second Architecture: The HEE Using Standard Technologies

In the second architecture, we intends to apply widely used web protocols (HTTP) and formats (XML,RDF) in the digital camera context. In this architecture, the digital camera acts as an embedded web server which serves snapshots stored in files but also snapshot descriptions stored in the database and the audio annotation files. This web server handles snapshot retrieval requests on several criteria. Response format depend on the terminal capability according to the HTTP content negociation. In this architecture, TV set, STB, PDA, Game Console, PC and other cameras are HTTP clients of the digital camera.

HTTP Requests to the Camera Embedded Web Server

Response formats are SMIL for next TV generation, DHTML for PC web browser, RDFPic[5,11,12] for camera-to-camera snapshot exchange and DPOF[9] for printing services.

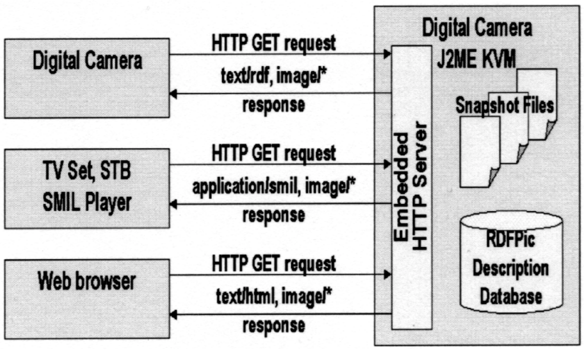

Figure 3. The HTTP-based architecture

RDFPic defines a set of snapshot properties using the RDF schema (Ressource Definition Format). The properties of RDFPic are those from the basic Dublin Core property (Author, Title, Description, Date ...) and photography specific properties such as technical properties (camera, film, lens, light, ...) and such as Content standard descriptions (Portrait, Group-portrait, Landscape, ...). To take into account digital album research criteria, we propose to complete RDFPic with additionnal properties such as the Location property. The value of the Location property may be either GPS coordinates or the name of a place (i.e. Eiffel Tower in Paris in France). Vocal description property will be also added to the RDFPic format. The RDFPic snapshot descriptions are stored in an embedded database.

These snapshot descriptions are transformed to DHTML, BHTML, SMIL and the brand-new DPOF with XSLT stylesheets. XSLT transformations can be done on the digital camera side before responding to a request, or on the client side (TV Set, STB, PDA, Game Console, PC, ...). However, camera-side XSL transformation is heavy (in memory and in CPU time). We are developping a transformer which will directly operates from the embedded database.

The camera embedded software must have a small memory footprint and must run on embedded operating systems. We choose PalmOS and WindowsCE to ease the developpement of the prototype in Java MicroEdition. We curently port an embedded version of the InstantDB database managament systems from Enhydra (http:// instantdb.enhydra.org) and we develop an version of an embedded HTTP server and an IP simplified stack for the IrDA port (PalmOS). This will enable the direct interchange of snapshots between two-camera over the IrDA.

The online demonstration has been set up, and presents some snapshots can be browsed with former formats (SMIL, DHTML and RDF) generated by the camera embedded server. This demonstration is available on http://www.univ-valenciennes.fr/LAMIH/ROI/SID/digalb and can be browsed with standard Web browsers (Netscape, MS Internet Explorer, ...) and with standard SMIL players (RealPlayer, GRINS, ...). The demonstration proposes also to select a subset of snapshots and to send them to a fictive printing web service.

Conclusion

This paper explains how with new storage and communication capability, the digital camera can extend, the set of printing possibilities and exchange with other digital devices. This new facilities are possible due to efficient search and selection of snapshots on the digital album. We have proposed two ways to implement these services in the Home Entertainment Environment: the first one using java-based technologies which a proprietary solution or a more standard solution using HTTP protocols and XSL style sheets transformers to adapt the printing or the display to several digital devices and standard formats

An other perspective is the definition of the interface of generic web printing services in the general business web context. We target the WSDL (Web Services Definition Language http://www.oasis-open.org/cover/wsdl.html) for the definition and UDDI (Universal Description, Discovery and Integration http://www.uddi.org) for the global registration of web printing services. Hence, users and applications will submit printing jobs with SOAP requests.

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Biography

Nadia Bennani is associate professor at the University of Valenciennes (France) since 1995. She teaches Computer Sciences and mainly Database and Information Systems to under graduate and graduate students. Nadia Bennani received her PhD degree (1994) in Computer Sciences from the University of Lille (France). Her current research interests include component framework development and security in nomadic and embedded computing and in smartcards. E-mail:nbennani@univ-valenciennes.fr. Tel: 33.3.27.51.19.49.