MMM2: Mobile Media Metadata for Photo Sharing

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ABSTRACT

Though cameraphones are rapidly becoming the dominant platform for consumer digital photography, users still face difficulties in transferring, managing, and sharing photos captured with cameraphones. The Mobile Media Metadata 2 (MMM2) system removes the difficulty in transferring photos from the device by providing an automatic upload capability and uses metadata about the context in which a photo was captured to simplify photo management and streamline the sharing process. In our MMM2 system, we have leveraged collaborative filtering techniques to infer the likely sharing recipients for photos based on contextual metadata, which allows the system to accurately guess likely share recipients for a photo and present them to the photographer at the time of capture.

Categories and Subject Descriptors

H5.1. [**Information interfaces and presentation (e.g., HCI)**]: Multimedia Information Systems; H.4.3. [**Information systems and applications]:** Communications Applications; H.5.3 [**Information Interfaces and Presentation (*e.g.*, HCI)**]: Group and Organization Interfaces.

General Terms

Algorithms, Design, Human Factors.

Keywords

Mobile Camera Phones, Contextual Metadata, Context-to-Community Inference, Wireless Multimedia Applications

1. INTRODUCTION

Cameraphones have several characteristics which set them apart from traditional digital cameras. Most importantly for our purposes, cameraphones are networked and programmable. Since cameraphones are connected via wireless networks they provide an opportunity to radically transform current photo management and sharing practices. Cameraphones also offer standard operating systems, programming languages, and APIs which enable custom software to capture contextual metadata at the time of photo capture. Specifically, our MMM2 system captures spatial, social, and temporal metadata [1]. Access to the cell ID of the nearest cell tower gives spatial resolution to several city blocks and GPS data, when available, gives location within several meters. Social metadata can be gathered by periodically polling for other devices within range of the phone's Bluetooth radio. Finally, access to a network time server allows access more accurate temporal data than is available from non-networked devices.

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In the MMM2 system we focus on supporting and simplifying cameraphone photo sharing by using contextual metadata and user profile and sharing history to answer the question: "With whom do I want to share this photo?" We deployed our MMM2 cameraphone photo sharing prototype with 66 users over 6½ months at the UC Berkeley School of Information Management and Systems. The results of our analysis of our MMM2 usage data, qualitative interviews and focus groups with MMM2 users, and experimental evaluation of our context-aware sharing recipients guesser algorithm show that we can usefully compute suggested lists of sharing recipients based on automatically gathered contextual metadata and patterns of user behavior. We computed the sharing recipients that users desired such that they would appear in the first 10 suggested sharing recipients 77% of the time—this feature was both useful to and used by MMM2 users resulting in an increase from 7 shares per week before the introduction of the share guesser to an average of 17 shares per week by active users of the system over the 6½ month trial. Using a collaborative filtering algorithm based on sparse factor analysis developed by Professor John Canny at UC Berkeley, we have a developed a smarter share guesser that suggests the actual desired sharing recipients within the top 7 suggested recipients 70% of the time [3].

2. RELATED WORK

Our MMM1 system addressed using contextual information at the point of capture to infer media content [1]. Other recent systems have attempted to simplify photo sharing through automatic uploading and displaying lists of potential photo recipients [7]. MMM2 not only enables automatic photo uploading, but also leverages metadata about prior sharing behavior and Bluetooth-sensed [5] co-present potential recipients to automatically rank and suggest sharing recipients for a cameraphone photo.

3. SYSTEM DESCRIPTION

The MMM2 system consists of client software running on cameraphones, and server software running on Linux machines. The client software runs continuously on the handset capturing contextual metadata and then uploading a metadata snapshot to the server along with each captured photo. The server manages photos, their associated metadata, and user profile information and generates HTML pages for display on PC or handset web browsers.

The client software runs on Nokia Series 60 phones and is based on the Context Logger developed by the University of Helsinki Department of Computer Science Context Project (http://www.cs.helsinki.fi/group/context/). The Context Logger

runs as a background process and records a variety of data from the phone device that is used to determine the context for a photo, including time, date, unique phone id, nearby Bluetooth devices, and location. The logger can communicate with a Bluetooth enabled GPS devices (we use the HP iPAQ Bluetooth GPS Navigation System) to record GPS location information. Context data is uploaded with each photograph, including the current cell ID, co-present Bluetooth devices, and current GPS reading if available. When a user captures a photo on their cameraphone (using the phone's built-in camera application), the Context Logger detects the new file and displays a screen allowing the user to set a caption for the photo. If the user chooses to share the photo, the MMM2 client connects to the MMM2 server and displays a list of suggested sharing recipients.

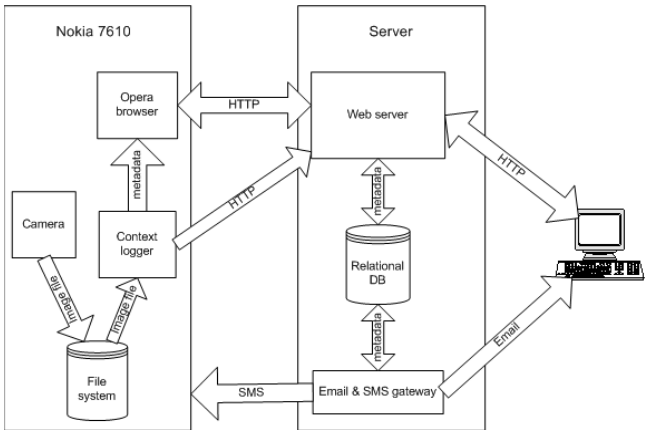

Figure 1: MMM2 System Architecture

The server produces two versions of an HTML-based user interface: one for PC-based browsers, and a more limited version for display on phone handsets. The PC version allows users to manage their photos (comment, caption, organize in albums, and share) and their personal profiles (set email address, phone number, photo receiving options, contact lists, etc.) The PC version also shows all metadata associated with a photo and allows a user to map unidentified Bluetooth devices to current system users. The phone version only allows browsing and sharing of photos and displays an abbreviated version of the metadata associated with each photo. When a user shares a photo (from mobile or PC) the server produces a customized list of suggested sharing recipients based on the contextual metadata associated with the photo and on the sharing user's prior sharing behavior on other occasions with similar spatial, social, and temporal characteristics (e.g., same time of day, same cell ID, or same devices sensed nearby.)

4. MMM2 USER EXPERIENCE

When a user captures a photo with the MMM2 system they are given the opportunity to share the photo immediately. If the user opts to share, the Context Logger launches the Opera web browser on the phone with the photo's contextual metadata encoded in the URL query string. The MMM2 server uses this metadata to generate a list of likely sharing recipients which is sent back to the phone client as an HTML page. If the desired recipient is not in the suggested list, the user has the option to navigate to a list of all their contacts. Once the user selects one or more recipients, the server notifies these recipients either via SMS to their phone or as an email with the photo attached. Regardless of whether the user chooses to share the photo immediately, the photo is uploaded from the phone to the server in the background, available for later viewing on the MMM2 website.

When a user visits the MMM2 website she has access to all her uploaded photos as well all those shared from other users. The site offers some photo management capabilities that are based solely on user input (e.g., grouping photos into albums) as well as some based on the automatically captured photo metadata. For example, users can view all photos taken nearby a selected photo (based on cell ID), view a street map or satellite photo of photo locations (based on GPS), view a list of other people present when a photo was taken (via Bluetooth co-presence information), or batch annotate groups of photos based on metadata similarity.

We believe that refining these photo management tasks that leverage automatically gathered contextual metadata and discovering others will be key in enabling people to manage their rapidly growing personal media collections in the future.

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