ABSTRACT
This paper presents VideoCittà, a system for sharing videos about physical locations. It promotes interaction between users engaged in cultural activities or that are interested in a given location. The system lets users upload their own videos, annotate and hyperlink content that was previously uploaded. It provides different modes of access including the Web and PDAs for mobile access. The system explores several new research directions, namely the generation of hypermedia structures from the existing materials as a way to provide personalized movie structures, the collaborative annotation of multimedia materials and the mobile access to geo-referenced contextual information. The paper describes the objectives, the overall architecture of VideoCittà with emphasis on the personalization and collaborative aspects and the results that were obtained so far with the development of the system.

The videos can refer to historical or cultural facts about a given place or can simply represent the view of a given user. Several concepts and research areas are explored in the scope of the project. Videos can be annotated by other users, with text, images or even other videos. This will contribute to creating a user community and at the same time to explore the generation of hypermedia documents from the original materials and the added annotations. Personalization is another main aspect that will be covered. We are exploring explicit and implicit personalization and also personalization features shared by groups of users. Finally, the mobile access is an important component that allows annotating and uploading video content when and where it is made. All these functionalities and requirements drive the development of VideoCittà, described in more detail in the next sections.

The paper is structured as follows: the next section presents related work on this area. Section 3 presents the overall VideoCittà project, focusing on the main features and functionality. Section 4 describes the system architecture.  The personalization aspects are covered in Section 5. Finally, Section 6 presents the conclusions that were obtained so far and directions for future work.

2. RELATED WORK
As mentioned above there are several influences to the work reported here and, as such, the related work is situated at the intersection of different research areas, namely personalization, hypermedia, mobile systems, and video annotation. There are also influences from tourist and city guides information systems. In the next paragraphs we present some of the more relevant related approaches.

There are many tourism-related services that emerged in the last years. CRUMPET [1] (CReation of User-friendly Mobile services Personalized for Tourism) allows planning travel schedules according to people interests. Its services takes advantage of integrating four key emerging technology domains and applying them to the tourism domain: location-aware services, personalized user interaction, seamlessly accessible multi-media mobile communication and smart component-based middleware that uses Multi-Agent Technology. In [2] another project using agent technology is presented. It introduces services technologies for tourism within a nomadic environment. The Krakatoa Chronicle [3] is an application using personalization and agent technologies. Video Talk [4] is an application for people to share their ideas and comments about the content of a recorded video. The pioneering
work on the Aspen Movie Map, created in the late 1970’s at the MIT is also relevant to the work reported here. The Aspen Movie Map made possible to travel continuously through a landscape. The Aspen Movie Map has one positional degree of freedom as well as Fly About [6], but in the latter the view is panoramic instead of fixed.

**Figure 1:** Adding an image annotation to a video

Personalization, in its different forms [8] plays an important in this type of system as a way to adapt the information to be delivered to the user considering its main interests and location [9,10].

3. THE VIDEOCITTÀ PROJECT

VideoCittà is a collaborative environment created to promote interaction between users engaged in tourism or other cultural activities, wanting to share their materials and their experiences, when visiting or studying a city or region.

VideoCittà is structured according to the geographical reality of the locations it represents, using a map as the main navigation mechanism. Behind the simple representation of the geographic elements that build the city, VideoCittà is, as its name implies a view of the city, trough the videos available for viewing and commenting. These videos can be institutional, commercial or, more generally, personal videos uploaded to the system by all the users who want to share their audiovisual materials to the community.

Taking notes is a natural way of expressing impressions or feelings about an external source of information. Paper is undoubtedly the traditional support for annotated materials and as to be thought as a reference concerning the basic needs and mechanisms of annotation. In VideoCittà users are invited to share not only their videos, but to share their views, their impressions, or the knowledge they have about cultural or historical aspects of the location, by annotating the videos. VideoCittà brings collaborative video annotation to the historical and tourism domains, enabling people to share their videos and to interactively provide additional information annotating the existing ones. Every member of the community may annotate their videos and those provided by other members, with no thematic restriction the annotations a user can provide. The personalization aspects that will evaluate the thematic relevance of a note to a particular user are discussed in Section 5. The annotations a user could see when viewing an annotated video, are constrained by the personalization subsystem that filters the annotations relevant for each user, based on the user profile. Figure 1 depicts the process of adding one annotation using the Web interface.

An important element in VideoCittà is related with the ability of accessing the system from mobile devices, located in the region covered by the system that helps to introduce the concept of geo-thematic relevance. The geo-thematic relevance is an element of personalization that tries to capture the geographical proximity of the user with an entity that is strongly connected with his main interests. This accounts for buildings or other architectonic elements, social events or just the physical location in itself.

Personalization plays an important role in the management of group interaction simplifying interaction between explicit groups (teams) and suggesting or promoting interaction between implicit groups, or members with similar interests. For the tourist user, we believe that the capacity to collect remotely placed messages could be fun, and motivating. In respect to group interactions, mechanisms exists that inform the user of the presence on site, of other members with interesting points in common. The location based features of the system in itself mechanisms of adaptation that give the user, information about the place where it is and the events taking place in its vicinity.

The VideoCittà system also contains mechanisms for the automatic generation of a movie that illustrates a tour around the city. This movie, made from the materials that exist in the system is personalized, meaning that the movie tries to capture the most relevant elements of the city according to the user’s main interests. The current prototype already contains mechanisms for the movie tour generation, and in a near future these features will be extended in order to incorporate the generation of narrative contents based on the user experience visiting the city.

4. SYSTEM ARCHITECTURE

One of the key aspects in the design of VideoCittà was the support for heterogeneous client applications, and the ability to deal with those differences in terms of client technology. A user may be connected to VideoCittà through a mobile handheld computer, a networked PDA equipped with GPS or trough the web browser of a simple personal computer. The adoption of an http based client-server architecture, was the basic integrating element, and made possible the adoption of a simple web browser as the simplest and weakest form of client platform.

4.1 Client Architecture

Besides the possibility of using a simple web browser to access VideoCittà, it was clear that in order to support the more advanced features of the system a more complex form of client architecture was needed.

The figure represents the conceptual model of the client application. The implementation of the different modules depends on the type of client device, where some modules that may be absent or present with reduced functionality.

Two elements will always be present: the interface and the communication manager. The interface is responsible for basic user interaction and must be able to display the annotated videos. The video composition may be client based, enabling full control of the audiovisual materials, or server based, more adapted for the weakest types of client devices. A SMIL [7] compliant interface is
currently available, Flash, Shockwave and QuickTime based interfaces are being studied.

The communication manager is responsible for the different types of communication devices that may be available at the client. Only the http connection is mandatory, but different communication modalities may be available depending of the client capabilities. As mentioned, remaining modules may be absent or with reduced functionality. The personalization module is used for storing local definitions about the user, the application and may be used as cache of retrieved and surrounding information, normally not depending directly from the server information. This personalization module may also have an important role in the gathering of user information and profile construction maintaining local or transient information about the user activity. This module supports the existence of client composition of the annotated videos, introducing extended personalization features. The geo-positioning module is responsible for the management of all the location based information, in the client. This module was developed for mobile devices but its use may be extended to non mobile platforms, providing support for simulation or augmented environments that deal with geo-spatial information.

4.2 Server Architecture

VideoCittà was built around a database backed web site with the additional features and mechanisms traditionally present in the so-called “virtual communities”. An Apache web server and an Apache Tomcat were used to support the http based access and JSP processing. Java Server Pages is the server side technology adopted in the first prototype.

Besides the http connection and RDBMS elements, the server architecture contains three additional modules related with specific features of the system. The Geo-Positioning Manager is responsible for the retrieving and processing of all the location based mechanisms associated with an user request. As previously noted the location based features are available for mobile, geolocated devices but may be transparently used by simulators in desktop computers. This module interacts with the personalization module for location relevant content delivery or interaction.

The Personalization and Group Manager is responsible for the management of the user information and provides input for the modules responsible for the actual content delivery. Information about the user interests, the level of relevance of a specific information to a given user, suggestions about locations, additional augmented information, or notifications about related users are processed by this module.

The Video and Annotation Manager, is responsible for the management and integration of the videos, the annotations, the video and annotation authors, and the information available about the locations represented in the videos. This module also plays a role in the server based video composition, creating personalized versions of an annotated video based on information provided by the Geo-Positioning, and Personalization Modules.

5. PERSONALIZATION

Personalization plays an important role in the usability of the system. The annotations provided by a community of users, make the viewing of an annotated video, difficult and time consuming. Some sort of user adaptation is necessary in order to deliver to the user just the information relevant to its needs or interests. The characterization of the personalization features available in the system is made in accordance to several aspects [8]:

- Content and presentation management
- User interaction
- Group Personalization

The content of the video and the additional information provided by annotations can be of an overwhelming diversity. The same historical monument may be relevant for different users by their cultural importance or simply by some personal reason. The first personalization approach in VideoCittà is made by simply trying to collect information about the user and his main interests, in order to suggest the type of information that may be relevant to that user.

5.1 Content and presentation management

The user is identified by the system trough a pre-registered username, enabling him to access a personalized portal where he can manage his profile. In the context of VideoCittà the user expresses his main general interests and the particular interest points in the city he is visiting or planning to visit. The interest points may be not only monuments or locations but also events or ceremonies that take place in the region and that may be held in different locations.

Besides the content adaptation, also the layout and presentation of the information needs to be adapted. The multimodal nature of the system implies the existence of mechanisms that provide content adaptation based on the characteristics of the user's accessing device. The user may be accessing the system trough small mobile devices as phones or PDAs, or trough a web browser. The type and volume of information that must be delivered to the same user, is constrained by the modality of access he is using. Over a
low bandwidth connection, an annotated video may be presented as a sequence of still images with only textual annotations superimposed.

The existence of location based services, brings additional roles to the presentation manager. The content delivered to the user may be adapted according to its location. The annotations previously made by the user may be available when he is near the point of interest, information about events, related spots may be adapted to its current location.

5.2 User Interaction
The role played by the user in the construction of its profile defines two types of user interaction: implicit and explicit. In the context of VideoCittà explicit personalization plays an important role in the definition of the user profile and in their particular interests about cultural or historical events in the city or region. If the user is accessing the system making plans for a visit or accessing it when touring the town, clear information about the user's interests are the key to provide him with information that relevant to the objectives of his visit. The system also uses implicit interaction, when making suggestions about information that may be interesting to the user. This implicit form of user interaction is also present when location based recommending is enabled. The information delivered to the user is constrained by his location, the user is implicitly defining its patterns of interest trough is geographic location. A non-interactive approach is also present and uses the information available about the user actions and navigation pattern to infer and make suggestions about items that could be relevant to the user.

5.3 Group Personalization
The group personalization is extremely important in the context of this project and we plan to address it in two different perspectives: information and communication. The information perspective deals with information targeted to specific groups. Communication in this context is related with group awareness mechanisms, enabling an augmented support for interaction within explicit and implicit defined groups. Explicitly defined groups, can be traveling companions or friends with common interests in a city visit. Common interests may also be found in groups of users implicitly considered, due to strong similarities in their profiles or characteristics. People from the same country probably share a common interest in information that may be related with its national country. Groups of fans of a music artist or adepts of a sport probably have common information interests regarding events related with that music artist or that particular sport

The group personalization is also important when addressing the problem of communication between members or users of the system. The concept of explicit and implicit defined groups still applies, almost the same way. Members of explicitly defined groups will want to communicate and the system will provide tools that easily enable this process.

6. CONCLUSIONS AND FUTURE WORK
Most of the components of the system, mainly the server and the Web client were built and the tests with users will start now. A prototype version of the hypermedia generation module was built allowing to generate a sequence of movies described in SMIL(Synchronized Multimedia Integration Language), but this module will be further refined to generate more complex structures. Future work will concentrate on interfacing profile information for personalization and providing mobile access to the system. Also, additional tools for communication and user notification are under development. We hope that the current functionality and the features that are being developed will allow VideoCittà to be used by different types of user communities, sharing their videos and their interests about the cities and regions that are more relevant to them.

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8. REFERENCES