M-Views: A System for Location-Based Storytelling

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ABSTRACT

M-Views is a system for creating and participating in context-sensitive, mobile cinematic narratives. A Map Agent detects participant location in 802.11 enabled space and triggers a location appropriate video message which is sent from the server to the participant's "in" box.

Keywords
context-aware systems, participatory media, wireless indoor location awareness, mobile cinema, storytelling

INTRODUCTION

As handheld computing becomes more popular, it will gradually incorporate context-aware features into everyday usage [1] [2]. Information selection will become easier because devices will infer what their users want—even before they pick up a stylus. While location-based marketing and instant messaging seem certain, less attention has been paid to the creative possibilities of context-aware, ubiquitous computing until recently.

Every person creates and receives stories. People talk to others, write in diaries, and send messages by phone, fax or mail. Over the Internet, this flow of information is enhanced by the speed, capacity and flexibility of computer technology. Email and webpages record our "personal narratives." Weblogs can be regarded as an evolving tour through the author's life [3]. This form of storytelling will inevitably migrate to the handheld, context-aware platform. Thus, there will be new possibilities for art and entertainment: interactive media that relates to the user's current environment. We are interested in exploring these possibilities.

Our goal is to build a system for the development and deployment of mobile, context-aware applications—specifically location-based, cinematic stories. This platform, *M-Views*, consists of the following components:

- Client-server architecture, allowing multiple clients to connect to a story server, which analyzes their context/location data and sends each client the next piece of its personalized experience
- Scripting language and authoring software [4], giving authors the tools they need to create and test location-based narratives
- Location awareness engine, which uses wireless network signal strength analysis to estimate the location of each handheld client

Figure 1: A mobile cinematic story

The resulting M-Views experience takes the user on a journey through the physical world, and pieces of the story—in the form of media clips—appear on the handheld at different locations. The selection, order, and timing of these clips are all unique; each person will experience the story in a different way, because with every movement, s/he affects its outcome. We call this interactive experience *Mobile Cinema*.

Mobile Cinema is augmented by physical surroundings and social engagement. As the participant navigates physical space, s/he triggers distinct media elements that often depict events at the location where they appear. The individual media segments are acquired at discrete times and places, with allowances for the serendipitous augmentation of the whole experience through instant messaging (done with the M-Views client). Since any system is only as good as its content, our research has also included the production of three mobile "movies" of this kind, which range from a mystery, to a college drama, to our latest story: an action thriller called *15 Minutes*.

M-Views was designed for Mobile Cinema, but its robust features allow it to have other capabilities as well. The platform can be used to support many types of applications.

TECHNOLOGY

The M-Views client-server architecture consists of multiple handheld clients connecting to a centralized server over a wireless (802.11) network. It makes use of an account/subscription service model, allowing users to subscribe to multiple stories at the same time. The server contains modules and information used for specific behavior, such as particular types of context monitoring or scripting operations and the location awareness engine. Story scripts are also maintained on the server and dictate the content and media to be returned. M-Views applications are defined by these story scripts.

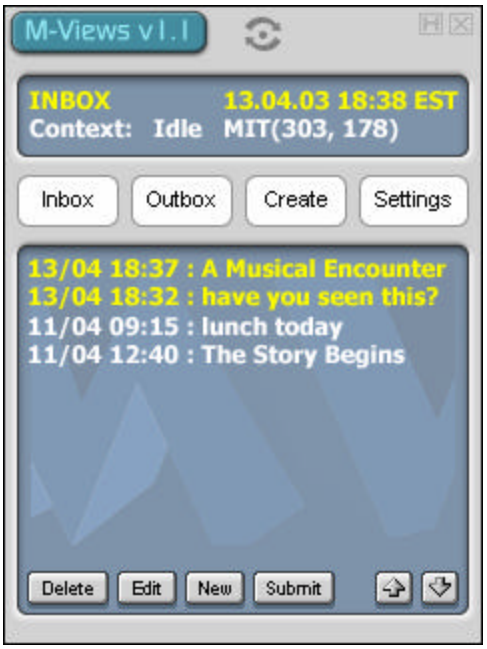

Figure 3: Client Interface on Pocket PC

M-Views Client

The M-Views client operates on the Windows CE operating system (Pocket PC). Each new event is dropped into a message queue, which is visibly represented as the user's inbox. In addition to the message manager interface shown in Figure 3, the client also features a map viewer/editor tool. This permits users to see their server-calculated positions and those of others. It also allows administrators to calibrate map coordinates using only the standard client. The software is modular and can be augmented for new functionality and sensors. It uses third party programs (such as Windows Media Player) to play streaming media over the network. When a message arrives with an associated media URL, the streaming media player is launched. The information flow is diagrammed in Figure 4.

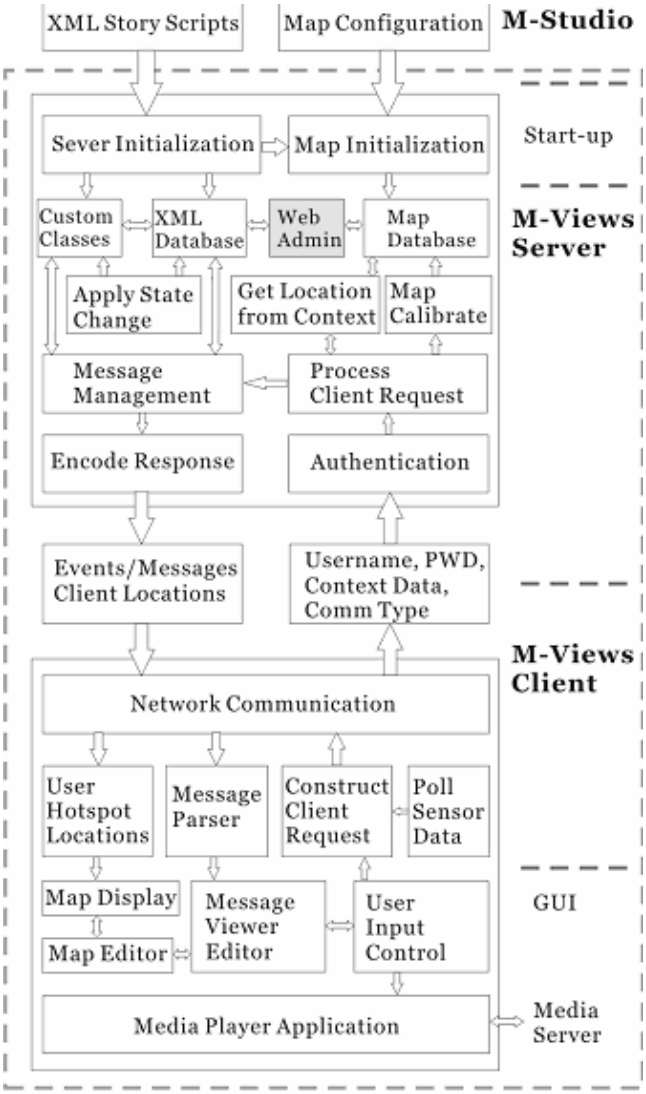

Figure 4: System Information Flow

Communication

Communication between the client and server is carried out via HTTP POST requests. Using this protocol provides both stability and portability. Every update cycle (approximately once per second), the client transmits authentication information, communication settings, and sensor data to the server, which then validates the information and sends back messages, story events, and location estimates. This communication scheme eliminates the need for a logon/logoff mechanism, and it is very fault-tolerant. If the connection is interrupted (perhaps due to losing wireless network coverage), the client will keep trying to send the last request until a connection is made or the program is terminated. To allow for roaming between wireless networks, the client attempts to reinitialize its wireless network card and DHCP address after any connection timeout or interruption. In practice, it takes about 10-30 seconds to reacquire a new network connection after the previous one has been lost.

M-Views Server

The M-Views server is written in Java and runs as a servlet with the appropriate container software, such as Apache Tomcat. After initialization, the server maintains all story, message, and user information as memory-resident XML data. XML management is done using the Apache Xerces 2 package.

The server features a messaging framework that is specifically designed to support narrative structures but flexible enough to be used for a full range of applications. Under this framework, all messages—whether they are client-to-client instant messages or events encountered in a location-based story—are processed using the same mechanism. All messages and events are stored in either a story script or the general message forum (to which all users are subscribed and where client-to-client messages are created). Additionally, all messages, even those sent by clients, can be made context-dependant and can have associated media URLs. These features, coupled with familiar functionality (i.e. message forwarding and group mailing), allow for an intuitive, robust, context-aware messaging experience.

Scripting

Story scripts contain a collection of messages (events). These XML elements include event information, requirements for the client's context and state variables, state change information (applied to a user's profile when he or she receives the message), heuristics that describe the content, and an associated Media URL. The scripting system is used to specify story behavior based on user activity, and each event element contains user variable requirements and results. If current variable values (maintained in the account data of each user) meet event requirements, the event is considered encountered, and the user's variables are changed according to any update rules that may also be defined for that event.

Location Awareness

MapAgent is the default location awareness engine written for M-Views. M-Views clients monitor the Received Signal Strength Indicator (RSSI) for all 802.11 wireless access points in range. These measurements are averaged over a small time window and transmitted to instances of MapAgent running on the server. For each subscribed map, the associated MapAgent compares the RSSI averages to measurements recorded previously by an administrator at known locations, which are called hotspots. Hotspots have a threshold, and they are represented on the map with translucent circles, as in Figure 6. The MapAgent algorithm uses a combination of nearest neighbor matching, triangulation, and trajectory estimation to determine client locations. The average accuracy is between 1 and 5 meters, depending on the environment, map resolution and calibration layout. It functions both indoors and outdoors. MapAgent also keeps track of all clients currently appearing on the map, allowing applications to incorporate a location-based social component.

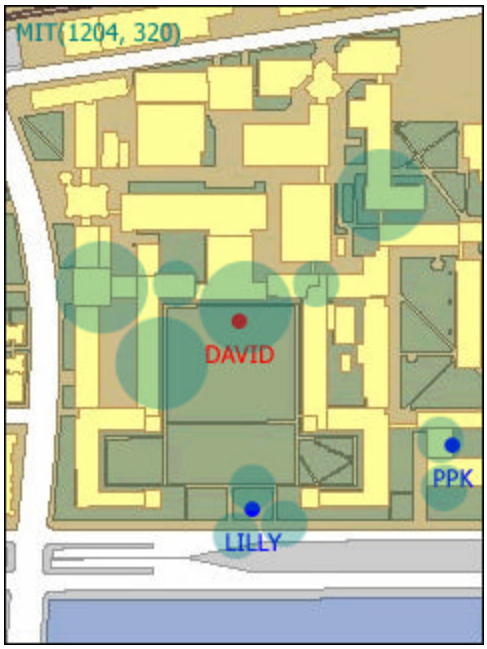

Figure 6: Map Monitor on the Client

STORY DESIGN

The need for good content has prompted the creation of numerous M-Views stories. These have included two large productions by students at the MIT Media Lab: a campus-wide mystery (designed as a time-dependent scavenger hunt) and a dramatic tour through the lives of students at MIT. Each production stressed different aspects of Mobile Cinema—in particular, nonlinearity and the connection with space.

Nonlinearity refers to the modularity of story clips. Authors must accept the possibility that clips will be seen at odd times or in strange orders. Therefore, the story and each clip that composes it must be able to withstand these uncertainties. M-Views authors have discovered that every clip should be entertaining independent of the other story material; each scene must have its own miniature "story arc."

Connecting with space is essential to the mobile experience. The small screen of a handheld device is a disadvantage in this regard. Therefore, it is up to the author to anticipate the interest and curiosity of the user. Carefully planned cinematography is the key here. Authors of Mobile Cinema have learned to give their audience spatial awareness and dramatic focus through use of motion, extreme close-ups, and wide establishing shots.

SIGNIFICANCE

Previous context-aware mobile media systems, such as the Cyberguide system [5], the Guide system [6] and the Hippie project [7], are all aimed at providing location-based experiences for visitors, city travelers, or museum tourists. All these systems adopt client-server architectures similar to M-Views, but differ in that they do not focus on the narrative aspect. In addition, few systems are full development platforms for mobile applications. None of this past research has focused on the development of cinematic narrative and little effort has been made to purposely support multiple kinds of mobile applications using these architectures.

M-Views breaks new ground by giving people the chance to author and experience Mobile Cinema with unlimited freedom—use it to create your desired type of mobile movie or game, or build your own context-aware application. Or simply write about your own life using the space around you as your medium.

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