Paper

MUMMY – mobile knowledge management

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Abstract— The project MUMMY funded by the European Commission develops means to improve the efficiency of mobile business processes through mobile, personalized knowledge management. MUMMY approaches the challenges of modern mobile work processes. To do so, it takes advantages of latest achievements in mobile connectivity and its capabilities (like "always on-line" high bandwidth personalization ubiquity), latest hardware options like camera-equipped handheld devices, and uses multimedia, hypermedia, and semantic web technologies. Technical development and appliance of the results are intensively consulted and integrated with business processes of several commercial organizations that are members of the MUMMY consortium. In this paper the achievements of MUMMY are introduced and individual components are briefly described.

Keywords— knowledge management, mobile computing, collaboration, multimodal interaction, SVG, RDF, context of use, facility management.

1. Introduction

A large, and still rising percentage of workers is doing some mobile business work. From the IT point of view, one of the immediate consequences is the increasing demand for being integrated into the global and corporate network both in case of recording new information and retrieving needed information.

The MUMMY[1] was a project, funded by the European Commission (EC) and the Federal Office for Education and Science (BBW) in Switzerland, to research and develop means to improve the efficiency of mobile business processes through mobile, personalized knowledge management.

The project resulted in a set of integrated components forming the MUMMY system. This enables mobile workers to never loose track and coherence of their mobile knowledge and provides:

- New approaches to mobile information and knowledge handling by extending knowledge management (KM) to support authoring, sharing, retrieval, and visualization processes in mobile work.
- Added value by just-in-time mobile assistance, facilities to speed up the workflow of spatially distributed business processes.
- Savings through efficient/natural forms of on-the-spot information capturing.
- Avoidance of delayed data entry and post-edit.
- Support for mobile cooperative (planning) processes.

[1]See, www.mummy-project.org

The activities in the project are concentrated on:

- New approaches to mobile information and knowledge handling. This will be achieved by extending KM to support key processes in mobile work.
- Just-in-time mobile assistance supported by context aware information processing in collaborative environment.
- Real-world experience and background through trials and work in the application areas of facility management, the building trade and the service domain.

The following chapters describe the functionalities of the individual components of the MUMMY system that implement the named functionalities.

2. Main features

The MUMMY system is a generic platform to support knowledge acquisition and retrieval in mobile business processes. The system and its components are able to support various areas of use. MUMMY focuses on mobile support in the areas of facility management and technical services. In particular the MUMMY core application (a specific adaptation of the MUMMY platform), specified in cooperation with ARCADIS GmbH, addresses the needs of mobile facility management.

In general MUMMY enables mobile workers to never loose track and coherence of their mobile knowledge, which means the MUMMY system meets the needs of mobile workers to **capture and access knowledge coherently** by an information-in-context approach using multimedia annotation and location/task-related assistance.

The main features of the system can be shortly summarized into the following categories:

– contextual behavior,

– data adaptation,

– advanced information searching,

– scalable vector graphics (SVG) collaboration, real time SVG annotation sharing,

– hypervideo,

– Grenoble components,

– problem tracking.

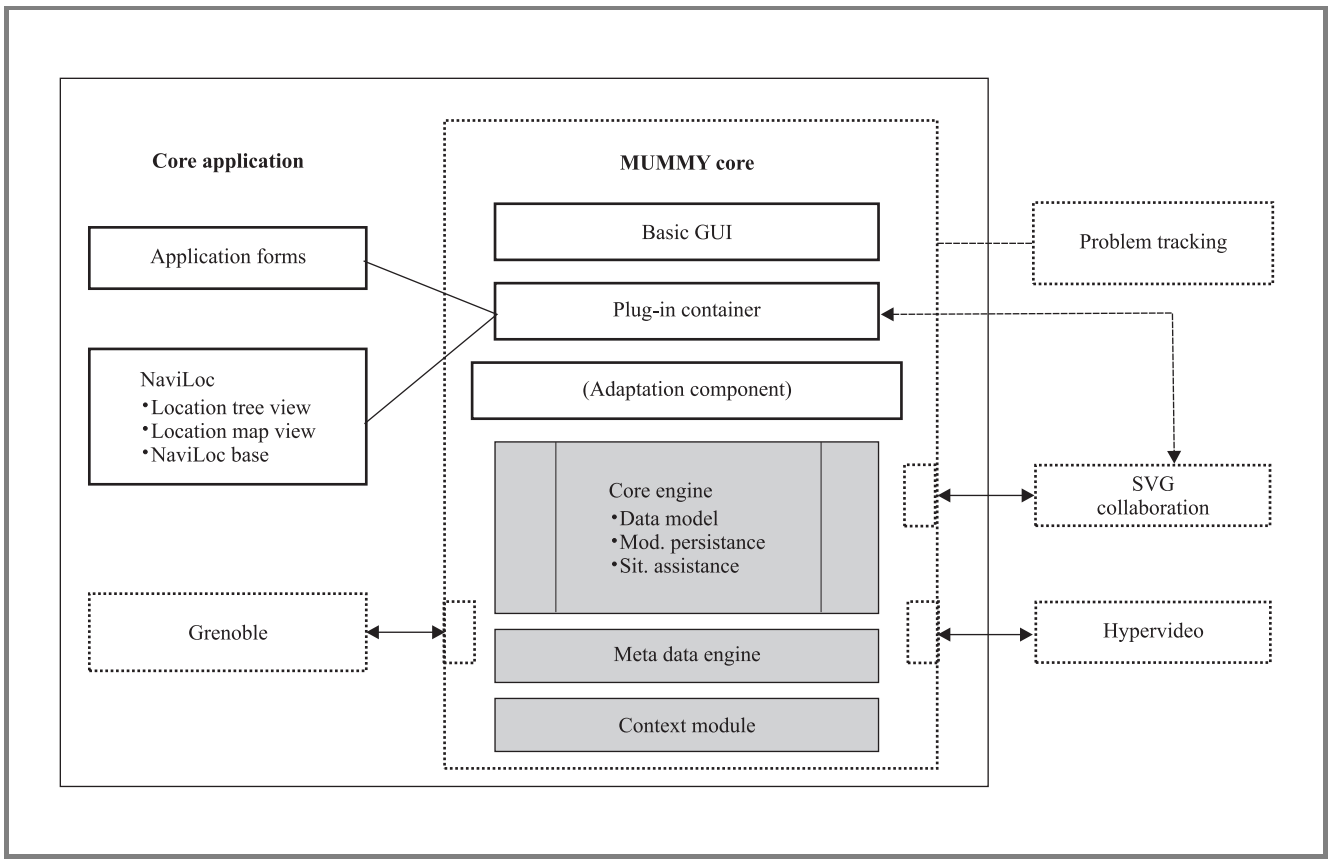

Fig. 1. MUMMY system components.

The named features were implemented by individual partners in the MUMMY project and finally integrated into one system (Fig. 1)

2.1. Contextual behavior

Nowadays most mobile workers document their insights in terms of paper-based notes and sketches and enter them into their databases when they are back in the office. MUMMY utilizes the new multimedia facilities in personal digital assistants (PDAs) to record the worker's comments. These comments in a form of photos, hand-drawn sketches, speech notes and simplified input forms are added to existing multimedia documents (such as videos with predefined hotspots, SVG drawings, maps and site plans). Thereby, the MUMMY system recognizes and **automatically correlates new recordings with descriptive information** from user's context (such as time, locations, people, tasks, and projects) in order to bring structure into the unstructured files and prepare them for advanced (semantic) search.

2.2. Data adaptation

User's context is utilized for a range of functionalities. Data adaptation is one of the representative use cases. The data adaptation process adjusts the application data to the current context of use utilizing information about environment, device, user and additional meta-information describing the multimedia data itself. The adaptation system is responsible for adapting the requested information to the current context of use and specified user query. For more efficient adaptation, besides the current context, the adaptation system utilizes additional semantic description of the adapted data (Fig. 2).

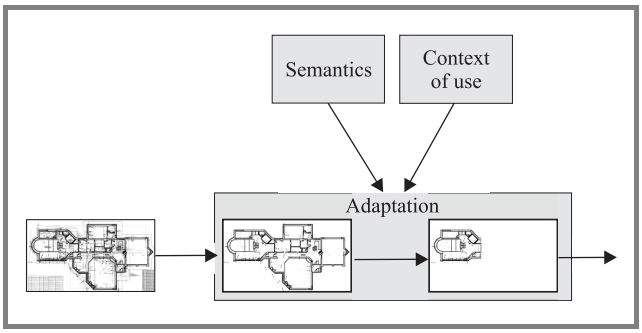

Fig. 2. Data adaptation process.

The result of the adaptation is data that fit the requirements of the user and the given context of use. The adaptation reduces the amount and complexity of delivered

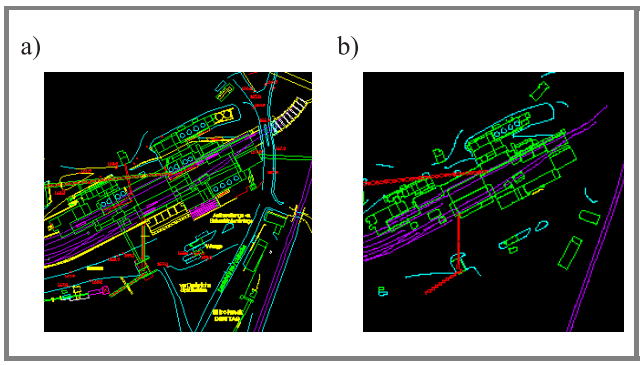

Fig. 3. Adaptation result example: (a) original document 2 439 objects, 376 kB; (b) filtered document 726 objects, 173 kB.

information so that it is usable in the mobile environment (Fig. 3).

2.3. Advanced information searching

During the data retrieval process in both the mobile and the stationary environment, the MUMMY system can utilize the semantic information for building a semantic network (metadata) for faster data retrieval. Users of the system have then the possibility to request data without precisely knowing their location. The querying can be also based on relation to other data, event or location. Building of the semantic network is done automatically as soon as the user creates the data, for example audio recording, photo, textual annotation, meeting schedule and so on (see Fig. 4 for

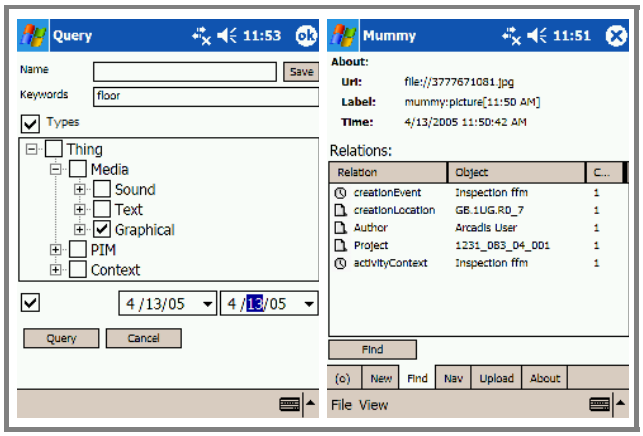

Fig. 4. Semantic data query tool.

semantic data query tool). The semantic information (metadata) is stored in a resource description framework (RDF) based database.

2.4. SVG collaboration, real time SVG annotation sharing

The goal of task collaboration and live sharing of annotations is to provide a tool and corresponding infrastructure for easier decision making and storing of acquired knowledge in mobile environment by enabling collaborative work. The system provides on-line data access to corporate database while using a variety of mobile devices like PDAs, notebooks and smart phones. As a basic data format for browsing construction plans in the mobile environment, SVG data format was chosen. This data format is designed for presenting of vector graphics and other hypermedia content on the web. The MUMMY architecture consists of mobile SVG editor (see Fig. 5), client network

Fig. 5. Mobile SVG editor.

component based on Jabber protocol and a server side collaboration and data sharing component. The collaborative architecture is depicted in Fig. 6.

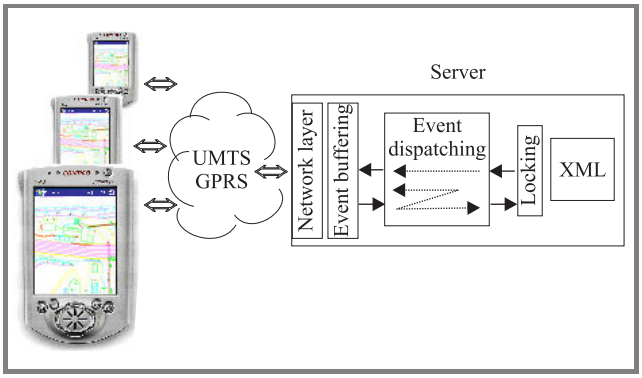

Fig. 6. Collaborative SVG system architecture.

The collaborative component is especially designed for the mobile environment and is therefore able to deal with the mobile network unreliability. Users can continue in work during short time connection failure. The changes made in the SVG plans are then automatically synchronized and distributed to all connected clients.

2.5. Hypervideo

Like SVG collaboration, the hypervideo module can be used either as a stand-alone application, or as an integrated part together with the MUMMY core and the MUMMY

core application. Hypervideo provides a complete set of functions to **use and author interactive video sequences**. Thereby, hypervideo combines details in a video sequence with other documents, which can be any form of multimedia (images, audio, video, text). These links to other media appear as visible and "clickable" regions within the authored video. Video annotation may emphasise specific parts of the video itself or the video material along a story line or a spatial path (e.g., the path of a site inspection). The latter case is integrated with the MUMMY core by interfacing the time/task/location/user-related management of inter-related information parts in context.

Finally, the hypervideo users can annotate video content during a presentation by combining certain details in the video sequences with own additional information in order to share their knowledge with others in the community. This collaborative use of hypervideo can be considered as a dynamic document, which can be modified and extended by conversations and discussions regarding group activities.

2.6. Grenoble

Grenoble supports in particular **pre- and postprocessing** of information needed or collected on-site during, e.g., a site inspection.

For preprocessing purposes it facilitates the interrelation of locations with tasks and media. These tasks and media will then be made available pro-actively on-site under the defined activation conditions, such as user's arrival at a certain spot.

In the postprocessing phase, visualization of interrelations is provided for both previously authored and mobile generated info items. The user is enabled to review consistency and completeness of "the information in context" and may alter and correct relations and data elements. Furthermore Grenoble provides a **report-generator**, which is able to export mobile collected inspection results XML-based into the customers report templates (e.g., MS Word Templates).

The main visualization methods and approaches to manipulate the interrelated data-space are not domain specific. In this regard Grenoble may be used as an external module extending the usability of the MUMMY core. However, as Grenoble is in particular designed for interaction with the MUMMY data models it can not be used completely stand-alone like the SVG and hypervideo modules.

2.7. Problem tracking

The problem tracking system facilitates the day-to-day operational tasks of field technicians in the technical service (TS) domain. It implements the current real-life technical service procedures employed in INTRACOM's TS department. Currently it operates as a standalone application but it can be integrated with the MUMMY core and use MUMMY core functionality. Main functionalities of this application are:

- Transparent information exchange between the TS "headquarters" and the field technicians based on bi-directional synchronization of the mobile and home data repositories. Synchronization can be performed *on-user-demand* and is optimized for reduced bit-rate data services (like GSM/GPRS).
- Representation of context information $\{user + time + task\ (product\ serviced)/location\ (where\ available)\}$ within its local database. This information can be used for automatic creation of context awareness and situation assistance information from the MUMMY core without any need for preprocessing.

3. The MUMMY use

As pointed out above, the MUMMY system is a generic platform to support knowledge acquisition and retrieval in mobile business processes. Potential MUMMY applications may therefore serve in a multitude of different business areas as a mobile knowledge assistant. In this section some possible ways to use MUMMY and its components shall be described. The main use of MUMMY is the mobile support for facility management.

Video-based e-learning. The hypervideo component can be used to support collaborative e-learning. A group of persons can interact remotely with interactive videos. These contain besides their obvious content clickable regions, which refer to more detailed information. The learning group can add further elements in the process of learning, can attach as well public visible questions and can track the history of discussion. All added hyperlinked information elements and discussion contributions can be searched and the referring part within the video can be jumped to immediately.

Mobile health-care support. MUMMY system can be used by companies for the provisioning of telemedicine service in order to provide remote medical help from nursing personnel and doctors to patients in distant locations. SVG collaboration can provide a very effective and intuitive way of working on X-rays images or other medical examinations (MRI, arteriography, ultrasound). The doctor in the headquarters will not only be informed at once but he/she can interact online on the image and may ask for more info from the local physician. All the files concerning the patient will not be lost or distributed across different hospitals but will be gathered in a central database consisting a very detailed and thorough medical history.

4. Conclusion

The MUMMY system has been implemented and individual components as well as the integrated system tested in

facility management scenarios. Currently the system is implemented as a functional prototype and members of the MUMMY consortium are considering application of the system in commercial sphere. Further development is expected in the follow-up projects.
The scientific results of the project were published in a number of conferences and scientific magazines (see References).

5. Project partners

The project MUMMY partners are:

- Zentrum für Graphische Datenverarbeitung e.V.
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  64283 Darmstadt, Germany
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- INTRACOM SA
  Markopoulou Ave.
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  8820 Wädenswil, Switzerland
  http://www.hsw.ch
- Czech Technical University in Prague
  Computer Graphics Group
  Karlovo namesti 13
  12135 Praha 2, Czech Republic
  http://www.cgg.cvut.cz
- COSMOTE
  44 Kifissias Ave.
  15125 Athens, Greece
  http://www.cosmote.gr
- ARCADIS
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  64293 Darmstadt, Germany
  http://www.arcadis.de

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Martin Klima received the Dipl.-Ing. degree from Czech Technical University in Prague, Czech Republic, and in 2000 he has began his Ph.D. studies in the same university. In 2001–2002, he was working on the adaptation of multimedia documents formats to PDA at the ZGDV in Darmstadt, Germany. Since 2004 he is working in the area of usability testing especially with special regard to mobile devices. His fields of interest are: mobile user interaction, data adaptation for mobile environment, and collaborative work in mobile environment.

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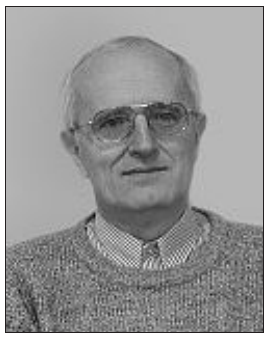

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