Collaborative Access through Semantically Enhanced Distributed & Diversified Cultural Content

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ABSTRACT

This paper reports specifically on the architectural and design issues associated with the development of web portal that will act as a conceptual platform of online utilities that enable users to collaboratively author and manage cultural resources in the globally distributed environment, featuring a web-based portal with multifaceted interfaces that can additionally be utilised as an educational and pedagogical tool delivering a virtual expedition. The project combines in a novel manner the research and exploitation of cutting edge technologies of ontology engineering for semantic web and distributed content management.

KEYWORDS: Semantic, Ontology, Distributed, Collaborative, Authoring

1. INTRODUCTION

MOSAICA (Semantically Enhanced, Multifaceted and Collaborative Access to Cultural Heritage) is the acronym of a project pursued by a consortium of European organizations. The specific objective of MOSAICA is the design and development of a highly advanced technological solution by creating a web-based portal featuring multifaceted interfaces for knowledge-based exploration and discovery and a conceptualisation platform of online utilities that enable users to collaboratively author and manage cultural resources in the globally distributed environment. Contemporary endeavours in the field of technology research related to cultural heritages is mainly concentrated in the development of digital technologies for capturing cultural objects, storage & maintenance of digital libraries and establishment of interconnectivity among these libraries. But collaborative utilization and shared access to distributed cultural contents is yet not made available for end-users and content publishers.

Therefore, the belief behind MOSAICA is that there are significant digital resources already existing either on WWW or in the so called DeepWeb. So there is a requirement to amalgamate this diversified content of differing format of increasing volume to a unique user experience and put them together for effective use from single point of access. Moreover, the highly conceptual complexity of the cultural resources requires their semantic integration & interpretation and high diversity of digital formats leads to different access interfaces and thus requires their seamless integration into unified display and presentation format.

This paper aims to present a progress report of MOSAICA's vision of utilizing state of the art technologies to facilitate content providers and end users a virtual environment for collaboratively author, manage and utilize digital cultural resources for both educational and entertainment purposes. Finally a discussion on challenges & innovations with regard to its development and integration are presented.

The rest of this paper is organized as follows. In section 2, we have described the current state of the art with rationale against specific design decisions as they relate to the project and the domain to which it is applied. Section 3 reports the progress so far in developing the high level features of the system and an architectural plan. It details the architecture particularly focussing on the distributed nature of the system with its features and how various systems technological option works together. A paragraph describing related research efforts has been added as section 4. In section 5, we present a discussion on

technological innovations that MOSAICA will deliver and the subsequent challenges faced by the project.

2. BACKGROUND RESEARCH

The process of authoring requires facilitation or implementation of collaboration tools and environments. The solution might be found in efficiently organizing and maintaining the resources based on the conceptualization of the contents within the domain of interest [4]. The domain we are considering here in this paper is the Jewish cultural archives of digital resources.

Web-based collaborative authoring environments allow users to create and edit pages using a web browser and they have achieved wide-spread popularity in recent years but there are two important limitations with current technologies [7]: lack of support for structured access, since they provide no means for navigating related information, except if explicitly added by users and no means for structured information retrieval by querying. Another is the lack of information reuse since information is only represented in natural language, it can not be automatically reused. For example, translations of pages have to be maintained manually. Adding semantics to such authoring environments through metadata annotations in addition to the natural language content will address these limitations. Information technology research on collaborative authoring focuses on providing an adequate software environment for the authoring process [6]. To facilitate the user with locating distributed contents physically situated at different geographical locations it is necessary for the authoring environment to have access to GIS utility tool. Besides, as contents will be of diversified formats the system should be able to support different formats of the content (e.g. multimedia contents).
So, the first step on attempting to arrive at a solution to the project goal of incorporating intelligent presentation and knowledge discovery of distributed diverse content to support web-based collaborative environment involved us in drawing together leading edge work in a number of areas; these are outlined in the following sub-sections.

2.1. Semantic Web technology for Collaborative Authoring

A Semantic collaborative environment will allow users to make formal descriptions of resources by annotating the pages that represent those resources in a formal way. The authoring effort will be relatively low with the help of an appropriate tool and the semantic annotations are very similar to the layout or structural directives that are already in widespread use in ordinary web-based collaborative environments. Use of the formal annotations of resources will offer additional features such as users can query the annotations directly or navigate using the annotated relations and users can introduce background knowledge to the system. Moreover, search and query facility can be greatly improved by introducing ontology oriented support [4]. The ability to annotate the work of others has traditionally been an important feature of collaborative systems. The ability to annotate Web resources and digital contents is a key criterion for authoring collaboratively [5].
With the emergence of the Semantic Web Standards (e.g. Ontology Web Language-OWL) automated semantic annotation of the textual content using NLP techniques gained significant interest. As the WWW started to get flooded with multimedia contents the annotation of audio-visual contents became more prominent with the advent of MPEG formats. In the recent years semantic annotation of web services rather than web contents gained more interests in the semantic web community. There are several attempts of developing solutions for semantic annotator of multimedia contents featured to function online or using OWL or handling cultural contents. Most of these applications were related to search and retrieval system for audio-visual content, rather than logical reasoning oriented approach.

2.2. Distributed Content Management for Collaborative editing

Due to the wide acceptance of the network-centric paradigm and the explosion of vast variety of media contents, enormous amounts of unstructured data have given rise to the need for systems capable of managing distributed content. Traditional content management systems based on the classic client-server architecture used a dedicated server for storage and management. However, such centralized servers require structured storage, reduces its applicability and do not provide the required scalability & reliability for handling cultural heritage contents. The huge popularity of the P2P file-sharing application on the WWW intensified the research on web-based distributed content management which is particularly focussed on the Distributed Hash Tables (DHT) that enable distribution of the indices used for search and retrieval on a large number of independent machines in a P2P network. But DHT suffers from the limitation of not being able to index large file names and extensive contents. When they are distributed on very large clusters of machines performance of DHT still cannot match the performance of centralized indexing systems. To counter these difficulties several proposed solutions will be researched further for the purpose of this project. The project's aim is to applying DHT to the ontology-driven indexing and distributing ontology-driven indices in a P2P network.
The project will also exploit the research efforts to overcome the low availability typical for the P2P networks.

Specifically the project will provide a platform for knowledge-sharing through collaborative semantic annotation, and development & sharing of the Virtual Expeditions. Thus it will enable collaborative editing in P2P network.

2.3. GIS/TIS (Geographic Information System/ Temporal Information System)

The application of ontology on GIS/TIS gained intense interest with the advent of semantic web initiatives. The idea of translating ontology into GIS led to the so-called Ontology-Driven Geographic Information Systems (ODGIS). Ontologies translated into software components are particularly useful for developing new GIS applications. Research in the area of integrating ontology into GIS is primarily focussed on ontologies to provide knowledge-driven componential software design for the geographic information systems, rather than on providing data to be used by them. The integration of ontologies into geographic information systems was never practically demonstrated, not even in an experimental system. For the first time, MOSAICA will attempt to practically display GIS/TIS data from multiple ontologies rather than from a preset database. GIS/TIS data will be provided with ontological information through semantic annotation without database editing. Such an attempt is completely a new innovation.

2.4. Multimedia Contents

One of the basic objectives of MOSAICA is providing solution for access and accumulation of multimedia content irrespective of its format, availability locations, device and network connections suitable for user requirements. As a result MOSAICA requires that the contents already exist in required format or the platform has the built-in capabilities to dynamically adapt the content on request. To meet such requirements the content management system must identify the characteristics of both content and its usage context, to decide the kind of adaptation needs to be applied and then should apply adequate adaptation mechanisms. In order to do it efficiently it is necessary to generate, store, convey and use meaningful shared descriptions of the identified characteristics.
The storage and access of the live content requires further research and development effort. Live contents do not have an end point in time without actual time of request for consumption. Each requested unit may contain a number of resources of different media types and their associated descriptions may be available on different networked peers. The MPEG-21 standard seems to be of suitable solution for the declaration of the parts that make up each item and its location. To provide universal and transparent access to multimedia content MOSAICA will incorporate MPEG-21 concepts into a distributed content management system. To describe the characteristics of the content and capabilities of terminals a further adaptation will be needed by combining RDF with MPEG-21.

2.5. Domain of Application

The project aims to apply the toolbox of technologies for intelligent presentation and knowledge discovery to digitise distributed and diversified artefacts relating to Jewish cultural heritage. It chooses Jewish heritage simply as an exemplar for the demonstration of results, though like any cultural heritage there are intrinsic reasons justifying the choice made.

The Jewish heritage was selected as a test case for other cultural, religious and national heritages and as a showcase for the technologies that could be effectively adopted for the presentation and discovery of the diversified cultural content and its use in education.

The project has envisioned a highly advanced web-based portal that employs educational and pedagogical tool delivering an interactive and creative educational experience. MOSAICA will aim to develop an educational framework and a platform for interactive inquiry and exploration of cultural heritages addressing problems of accessibility. This research will be directed towards the development of the methodology and the technology for *Virtual Expeditions (VE).*

Virtual Expeditions are a specific educational instrument based on conceptual modelling and designed specifically for learning through exploration of virtual Worlds. The Virtual Expedition will be designed as a step-by-step procedural approach to the thematically driven conceptualisation of cultural resources. In order to develop a framework enabling design, recording and automatic execution of Virtual Expeditions an online editing tool will be designed empowering end users with the ability to create and record their own Virtual Expeditions. A few exemplifying Virtual Expeditions will be designed for demonstration purposes. MOSAICA's *Repository of Educational Resources* will contain ready-to-use educational material thematically organized allowing users to select the topic of interest and gain access to all relevant materials. At each step users will have the opportunity to both broaden and deepen their interest by following semantic links to related material with a high level of interactivity.

3. PROGRESS REPORT

In this section we report on the progress so far. Since the start of the project we have conducted an in depth survey of

interactive systems and intelligent presentation systems as well as consulting with potential users to arrive at a set of requirements for the proposed system [2]. These have been analysed and synthesised into a set of high level features, which themselves have been refined into system architecture.

3.1. System Features

The proposed system has been envisioned as a highly advanced web-based portal which can be utilized as an educational and pedagogical tool that provides a creative experience via a interactive virtual expedition tour. MOSAICA as a web-based portal has the following features -

- Multifaceted interfaces for knowledge-based exploration and discovery
- Online utilities empowering users to collaboratively author and manage cultural resources in the globally distributed environment

MOSAICA can be utilized as a cognitive tool in three different ways -

- *Explorative usage* - The multifaceted interface of MOSAICA will enable users to visit and explore places of interest simply by zooming on the GIS empowered map or by exploring the semantic directory or merely by submitting a query. As a result users are free to travel virtual world of Jewish heritage anytime they wish with the ability to create & save virtual expeditions of their own choice or simply by using existing pre-planned expeditions.
- Guided usage - MOSAICA will offer users with various recommended Virtual Expeditions classified by topics and objectives. Thus it provides guiding facility to the user including suggested start and end locations of a virtual expedition with differing time span and with the display of selected artefacts etc.
- *Collaborative usage* - MOSAICA allows any user (educational personnel or individual user) to share their cultural knowledge by letting them annotate any cultural object either with free-text comments or semantically annotate using MOSAICA tools. Besides, users may contribute any cultural artefact as a content to exhibit them online.

Moreover, virtual expeditions created by users may be saved to the Repository of Educational Resources for sharing by other users.

3.2. High Level Architecture

From the document [3] which details the requirements their categorisation and prioritisation we were able to develop through analysis and synthesis an architecture which is detailed below.

As an application MOSAICA does not own the resources it uses. Inspired by the extremely distributed approach MOSAICA is based on Service Oriented Architecture (SOA). It wraps the WWW with a structured collection of essential *Web Services*. At the heart of MOSAICA is its *Semantic Layer*. The block of *Online Utilities* provides functional tools to handle manipulation with the semantic layer. The *Logical Reasoning and Inference Engine* utilizes these services received from semantic layer to interact with various *Multifaceted Interfaces* in order to provide the required application functionalities to the end users. As shown in figure1, data flow denoted by grey-coloured arrows represents data from external distributed web resources. Solid black-coloured arrows indicate data flow within the MOSAICA infrastructure and dotted black-coloured arrows indicate edited data.

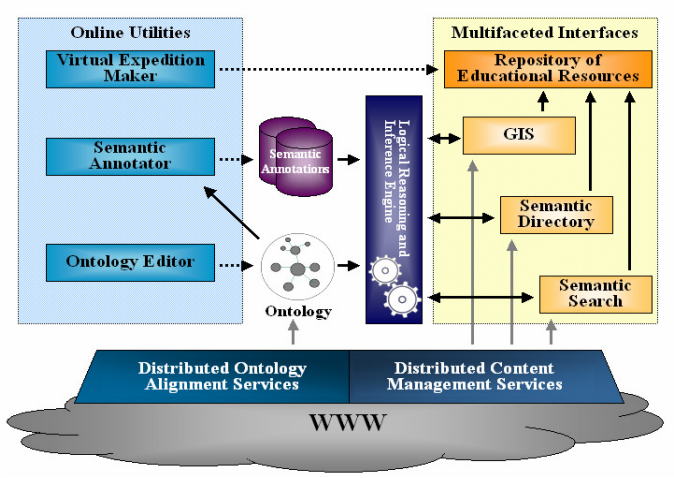

Figure 1. MOSAICA high-level architectural design

Web Services

The layer of web services is designed to provide service access to the distributed web resources. This layer is further classified into two types. If the web resource is web-based ontologies they are accessed by the *Distributed Ontology Alignment Services* that provide dynamic and online integration of multiple ontologies. Otherwise the resources are accessed through the *Distributed Content Management Services*. Besides, *Distributed Ontology Alignment Services* are also required to use the *Distributed Content Management Services* to ensure the high-availability of the underlying ontologies through the replication mechanisms provided by the *Distributed Content Management Services*.

Semantic Layer

The semantic layer consists of two repositories- *MOSAICA Ontology* which is dynamically integrated *and Semantic Annotations* of distributed repositories. Both *MOSAICA Ontology* and the S*emantic Annotations* provide a virtual layer for efficient querying rather than staying as a static

store of ontologies. Logical Reasoning and Inference Engine applies logical reasoning to the reference ontologies and provides the required data & functionalities to the end users for various multifaceted interfaces.

Multifaceted Interfaces

The end users may utilize functionalities from interfaces such as Repository of Educational Resources, GIS, Semantic Directory and Semantic Search. Repository of Educational Resources serve as a store of resources for Virtual Expedition Maker utility and it displays the resources in the required format.

GIS utility will be empowered with semantic references to geographical maps and displays rather than hard-coded geographical data. Interaction of GIS utility with the inference engine will enrich spatial navigation by extending to temporal dimensions. This extension of GIS into temporal dimension is sometimes labelled as Temporal Information System (TIS). Any request for zoom-in on the GIS map will actually be conveyed to the inference engine that queries MOSAICA ontology in order to find associated info. If this info is a spatial plan which is a web resource such as a graphic file located on a web site museum GIS will submit the request to the Distributed Content Management services to coat the plan with a layer marking the position of various exhibited artefacts or broadcasted webcam streams for example.*GIS*, *Semantic Directory* and *Semantic Search* are used for exploration and discovery of the content, and also provide input for the creation of Virtual Expeditions. Unlike hierarchical directory structure, MOSAICA S*emantic Directory* will allow conceptual navigation by following additional, complex semantic relations.

Semantic Search Engine will facilitate search and retrieval with logical reasoning allowing semantic inference extending the keyword querying. Both semantic directory and semantic search engine will allow integrated access to the diversified (in both content and format) cultural resources by seamlessly aggregating them into a single conceptual frame.

Online Utilities

There are three online utilities: Virtual Expedition Maker, Semantic Annotator and the Ontology Editor. Virtual Expedition Maker creates virtual expeditions; those are preserved as additional distributed Web resources that are exposed through the Repository of Educational Resources. MOSIACA Ontology can be edited and/or created through the online *Ontology Editor*. The results are preserved as an additional Web resource that will automatically be integrated into MOSAICA Ontology at the semantic layer through the *Distributed Ontology Alignment Services*. The online *Semantic Annotator* also utilizes the MOSAICA Ontology and produces semantic annotations. The results of the ontology editing and semantic annotations are also preserved as additional distributed Web resources.

4. RELATED WORK

Sinclair et al. [9] describe the use of ontologies to integrate access to cultural heritage and photographic archives. The use of the CRM (conceptual reference model) Core ontologies are described together with the metadata mapping methodology. Their proposed system demonstrated integrating data from only four content providers. Valtolina et al. [10] present a framework able to support the end users needs of customizations by adapting the system components according to their context of use e.g. access through PDAs. The framework utilizes CRM models and has developed tools supporting a personalized access to cultural heritage collected in multiple museums. Information items linked together according to associative and semantic links result in a large number of possible "information trails" (narrations) that corresponds to an author's line of thought; by following different narrations, a user can see the information from different perspectives. Authors and users can rely on a shared understanding or terminology composing each cultural heritage. Vlahakis et al. [11] implemented a personalized electronic guide and tour assistant to cultural site visitors. The system provides on-site help and 3D augmented reality reconstructions of ancient ruins, based on the user's position and orientation in the cultural site, and real-time image rendering.

5. DISCUSSION OF INNOVATION AND CHALLENGES

5.1. Collaborative Authoring

According to the 'Good Practice Guide for Developers of Cultural Heritage Web Services' [7], web portal such as MOSAICA should allow users to publish (create and edit) content over the web using collaborative software within the web environment without the need to download any special software. Also, it is required to have the ability to simplify the content creation and editing facility by allowing simple annotation/mark-up technique to share the content with other distributed users. Moreover, virtual environments involving cultural contents distributed geographically must be richer in terms of freedom of navigation and ease of interaction [8].

MOSAICA aims to provide user friendly interfaces for two kinds of users: End users are defined for explorative, guided and/or collaborative usage; in short these are anyone that wishes to use MOSAICA. Another type of users is administrators who will monitor the quality of the heritage items and the self-made VE. End users will also be able to act as collaborative users and create heritage items and/or

their own VEs. They will be able to share heritage items, and receive and give commentary and remarks.

5.1.1. MOSAICA's Subsystems for Collaborative Usage

Each subsystem is responsible for different components and manages different areas of interaction.
The subsystems include:

- Collaborative System for adding ones own Heritage items
- Distributed Content Management System for collaborative editing
- Assessment and Editing System (for acceptance and rejection of uploaded heritage items)
- Administration System (for allowing different authorizations and monitoring the uploaded items)

5.1.2. Publishing Content

We need a system [15] that will allow users to create their own "heritage items". Clicking on a button labelled as "create your knowledge item" will present a text box allowing the user to write a short paragraph and attach a related file (photo, picture, scanned letter, video) (see MQSIA's screen shot) . Clicking on a button "add a new item" will add the item to a pool of items waiting for the approval of an administrator/editor (a school teacher, a museum employee, or peer users). Once read and approved, the editor clicks on an "approved item" button and the uploaded "knowledge items" – the visual and textual files will be displayed. So, users in the collaborative mode will be able to upload visual features with accompanied text, choose relevant key words from a scroll down bar, add relevant key words, add the date/time era, mark a relevant location on connected to GIS map, indicate the source of the item (private collection, museum, etc.), indicate identifying data (name and the group he belongs to, i.e. organization, school and class, community etc.) and contact information (email) and indicate the general theme and sub-theme that the uploaded heritage item belongs to (providing a scroll down bar is recommended). Enabling the identification of the sources of content, general and originator locations are important for the administrators as it will allow them to track their users and monitor the uploaded content.

5.1.3. Peer-assessment

We need a system that will also allow users to respond to the heritage items presented by their peers. Peer assessment facility will allow users to open a heritage item read it and comment on it. Commenting on each others' work would ease the administrators' workload and bring further involvement and sharing among users, in other words such facility will enhance collaboration on authoring efforts.

5.1.4. Administrators' Monitoring of Uploaded Heritage Items

The administrators will be enabled to select heritage items that are under their responsibility from a pool of items. Their selection will be by username, group, or theme. The administrators will also be able to see the uploaded heritage item, edit it, accept or reject the item. Once accepted, the item must be presented in MOSAICA's content inventory.

5.2. Semantic Web and Ontology Engineering

MOSAICA's semantic layer provides users with support for semantic annotation, browsing and both basic & advanced search functionality [figure 2]. By using semantic annotation, content publishers/authors on the WWW can associate various content items with multiple ontology concepts that are then used as a semantic index to search and retrieve the annotated content. In spite of the immense application potential of semantic annotation there are very few tools available. However, these tools are not suitable for the content-driven annotation required for the cultural objects and they lack in their ability to describe web services. Use of multiple ontologies for semantic annotation of cultural objects is already in practice by several projects. MOSAICA also follows the same idea but additionally in a novel manner it utilizes multiple ontologies for semantic indexing and design a user friendly OWL-based annotation tool specially orchestrated for cultural objects. Ontology alignment allows merging and combining of multiple ontologies and provides a way to manipulate them as a single ontology or knowledge base. There are many existing ontologies and controlled vocabularies available. But none of them is sufficiently complete. So the project will use ontology alignment to enable use of multiple distributed ontologies already available over the web and thus results in a general directory (called semantic directory) which is composed dynamically and online. Every cultural heritage has its own terminology and hence the need for multilingual explanations and labelling. Moreover, this novel application of ontology alignment in MOSAICA will provide a very valuable unified conceptual frame which is independent from the display language. Therefore the general multilingual directory will serve as the semantic index irrespective of the language of the display content.

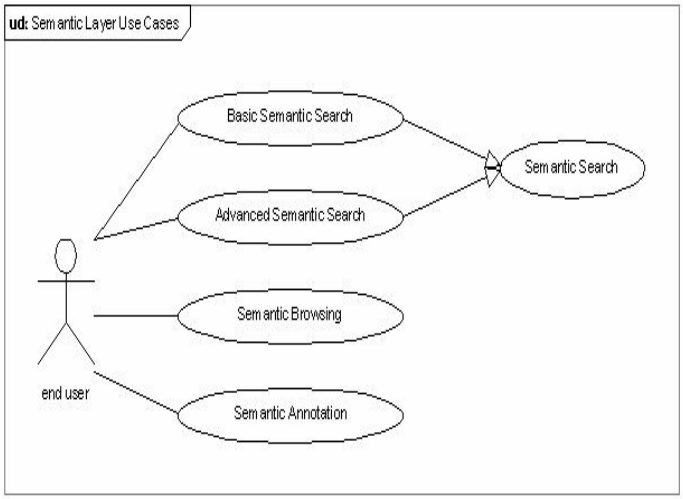

Figure 2. User is making a Semantic Search, Semantic Browsing or Semantic Annotation

Ontology alignment using the transformation of relational database schemas into XML schemas and then into RDF is limited to manual approach for a well-known database schema. As a result it is unsuitable for MOSAICA target of both schematic and semantic alignment of heterogeneous resources. So the goal is to allow users to semantically annotate the resources regardless of their format and origin as well as associating each of the resources with one or more reference ontologies. Textual contents will be annotated using the cutting edge NLP tool known as SANDRA (Search AND Retrieval Application (SANDRA) is an NLP system designed to index multilingual documentation by using controlled vocabulary from ontologies in RDF/XML and OWL formats. SANDRA will be contributed by one of the consortium members.). MOSAICA's semantic annotator will enable content publishers (both end users and website owners) to semantically index the content (multimedia clip, 3D image or web cam streams) and expose it through the MOSAICA semantic directory and thus bringing the concept of collaborative authoring to reality.

Ontologies formally represented in description logic facilitate logical reasoning and thus allow inference of knowledge that was not explicitly presented in ontologies. Inferential knowledge hidden in ontology makes it more powerful than a simple index or directory. Currently existing browse-able websites through semantic indexing are based on the linguistic relationships of metadata keywords (e.g. synonyms and antonyms) and utilizes ontological references from RDF formatted resources. Whilst MOSAICA adopts the same basic idea, however, instead of using RDF it uses OWL and thus enables logical reasoning over ontologies. The reason for using OWL instead of RDF is that RDF supports logical inference to a certain extent, based on customized relations defined in RDF. On the other hand OWL offers hierarchical relations and data types as its primitives. So it is far more suitable for MOSAICA objectives. MOSAICA will therefore provide a classic search engine (based on OWL) interface with the novelty of inference capability.

5.3. Using GIS/TIS

To enable rich user interface for semantic browsing of geographically distributed cultural artefacts and fulfil the general requirement of a web-based authoring tool of such items, a GIS/TIS interface has been added to the MOSAICA portal as a utility. The user may want to see the location of an object (current or original) by clicking on the object through locating it on a GIS enabled map. These components take the currently selected object and use its semantic description to show it on the map. Another way of using GIS-based maps is having a collection of maps with active buttons on them. When the user clicks on an active button a heritage item (picture & text) pops up in a separate window. It is important to note that sliding the mouse on top of the buttons should result in the transformation of the arrow into a hand figure (or any other icon for this matter) presenting a short description of the item. The user can select geographical area [figure 3] whether by clicking on a location and defining the distance or by dragging a diagonal line (to make a square). The relevant results can then be sorted by the semantic search tools. Virtual Expedition tool will use GIS/TIS as a part of the creating their own expedition, and as assignments such as locating a place on a blank map.

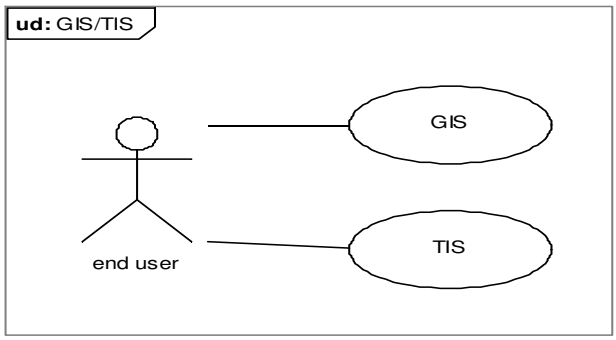

Figure 3. User selects GIS/TIS component for the current object

5.4. Distributed content management

MOSAICA's distributed content management infrastructure will enable a single access point to diversified content formats from heterogeneous sources and will seamlessly integrate various digital formats such as multimedia

documents, 3D images or streams from web cameras into single display frame and treat them all as semantically annotated virtual cultural objects. This will include offering essential services for distributed semantic annotation, collaborative authoring, maintaining repositories across distributed network as well as access to the contents from heterogeneous client platforms. Similar projects in this context only target archives and repositories with well defined interfaces and database schemas. But MOSAICA's target is just any cultural object that can be represented as virtual web resources. Unlike existing practices MOSAICA doesn't target only textual information and clearly defined metadata but it as a challenge it considers non-textual formats (e.g. web cam streams) without uniform metadata structure.

5.5. System Integration and Application Development

The completely distributed MOSAICA architecture poses a real challenge for integration as it combines several cutting-edge technologies. So it has been based on Service Oriented Architecture. Distributed content management system, utilizing the P2P model and JXTA framework is at the core of its integration. All other system components will be built on top of it or may be integrated using its basic services. The system integration will be based on the system's architectural design and specific requirements defined by different stake holders such as content providers, consortium partners etc.

6. CONCLUSION AND FUTURE WORK

We have presented a summary of the MOSAICA project (funded by the EU IST framework-IST-034984) detailing its motivation, features, architectural plan, novelty and technological innovations. The system will be designed to fuse together a number of diverse cutting edge technologies such as ontology engineering, distributed content management and ontology integrated GIS technology so as to develop a diversified toolbox of reusable components, allowing their broad application to other diversified cultural heritages and traditions. Primary focus of the project will be on the digitised cultural objects of different multimedia formats. Multifaceted portal will feature interactive and user friendly interfaces. Semantic annotator based on multiple ontologies will specially be built for publishing cultural contents with multilingual capability. Virtual expedition maker will extend the use of MOSAICA technology further to education sectors.

We are currently in the process of creating MOSAICA core ontology that will form the basis of semantic layer for the system. Also the basic infrastructure for content management system is underway. Simultaneously, we are working on creating mock-up screenshots for user interfaces.

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