IOSR Journal of Computer Engineering (IOSR-JCE)
ISSN: 2278-0661, ISBN: 2278-8727, PP: 61-63
www.iosrjournals.org

Using Linked Data to Context-Aware Annotate and Search Educational Video Resources

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ABSTRACT : *Video resources play an important role in education. Large number of educational video resource is created by different organizations and institutions for study that are available through the multimedia web. Most of them video resources are annotated which lack semantic connection. Thus, facilitating for annotating such video resources is needed. Most of the educational video resources are available as non-semantic, non-linked manner and without context-aware technique. Using Linked Data technology we can semantically annotate video resources as well as these annotated resources linked to other video resources that are available on web. These facilities provide semantic connection between videos and their metadata understood globally. Here two online tools to be developed. First online tool used to context-aware annotate educational video resources and another tool for semantically searching these video resources.*
Keywords - *Educational video resources, linked data, semantic search, web services.*

I. Introduction

In education, it is important for e-learning to explore, share, reuse and linking the educational video resources. There are problems regarding semantic connections in video resources that are currently annotated. Using Linked Data technology, it helps to users to semantically annotate the educational video resources as well as to browse semantically linked educational video resources from different online resources. It is also very beneficial by applying Linked Data technology for re-usability, scalability and extensibility. Large numbers of free educational resources are available on the web due to rapid growth of multimedia web. So, to develop learning activities, it becomes very difficult to search for all related, distributed educational resources together. It is identified the following primary challenges: i) Video resources should be described precisely, ii) The description of the educational resources should be accurate and machine-understandable, to support related search functionality, iii) Linking video resources to useful knowledge data from the web. Hence our goal is to design and implement a framework to rectify these problems by using Linked Data technique, combining a context-aware annotation technique to speed up the annotation process.

II. Related Work

The Semantic Web [1], in which the meanings of information on the web are defined, therefore, it is possible for machines to process it. To use ontological concepts and vocabularies to accurately describe contents in a machine readable way, it is the basic idea of Semantic Web. These ontological concepts and vocabularies can then be shared and retrieved on the web.

In the Semantic Web, each piece of the description is a triple, based on Description Logic [2]. So, the implicit connections and semantics within the description pieces can be reasoned using Description Logic theory and ontological definitions. The research work on the Semantic Web focused on defining domain specific ontology and reasoning technologies. Therefore, data are only meaningful in certain domains and are not connected to each other from the World Wide Web.

Study [3] uses a domain ontology that describes the videos to classify annotations. Here, the domain ontology-based annotations cannot annotate information from outside of their domain, which restrict to student to gain extra knowledge from other domain.

Earlier video annotation tools are as fat-client software rather than web browser based, or non-Linked Data annotations. An important system was Vannotea [4] which relied on a dedicated client application to enable collaborative annotation, but the annotations were not in a Semantic Web style.

MPEG-7 [5] is initially designed based on non-semantic XML description language. It focuses on video text, presentation models, pictures, graphics, audio volumes, and searching matrix with relating to information about the video. So, these are always fat clients rather than web browser based.

III. Proposed Work

The proposed framework as shown in Fig.1 consists of three basic phases: video annotation, browser platform and evaluation.

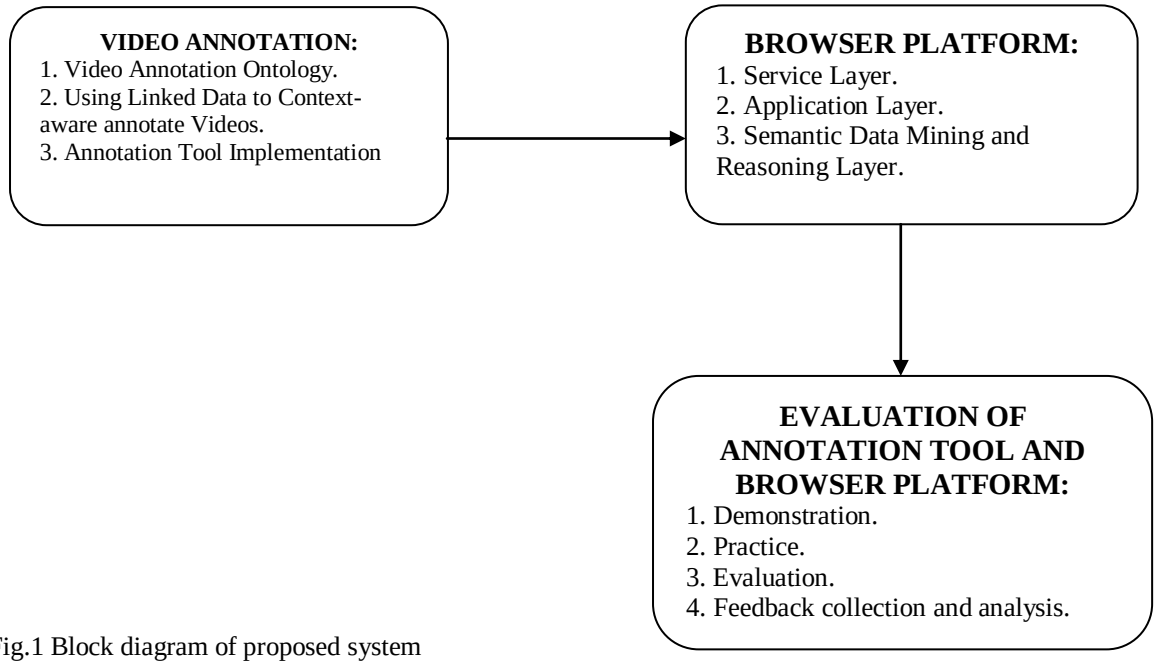

Fig.1 Block diagram of proposed system

3.1. Video Annotation

It is a web application, which allows users to view a video and add Linked Data annotations to the video timeline.

3.1.1. Video annotation ontology

In this step video annotation ontology and annotation instances are stored in Sesame RDF quad store, and ontology reuses a number of RDF vocabularies.

3.1.2. Using linked data to context-aware annotate videos

In this step Linked Data is used to handle properly annotation issues, such as accuracy, disambiguation and completeness. Following Linked Data Services are used as Dewey Decimal, Library of Congress classification, GeoNames, and Zemanta.

3.1.3. Annotation tool implementation

In the last step of Annotation, online annotation interface is to be implemented. This interface is divided into four parts: Flash video player, List of current annotations, control for video player and for entering new annotations, and to help the user to find new Linked Data URLs, set of panels is provided.

3.2. Browser Platform

It is to be developed to facilitate the usages of educational video resources that are annotated by annotation tool. Semantic Web approach is used to search videos and explore their related online resources. Here annotations are matched semantically to other annotated educational resources from the web. Browser application has three layers as: Service Layer, Application Layer, Semantic Data Mining and Reasoning Layer.

3.2.1. Service layer

Here some Linked Data Services as well as non-Semantic Services are used in browser application.

Linked Data Services are: WorldHistory, and Sindices. WorldHistory-that provides API access to retrieve the information about people, events, places. Sindices-that is a semantic search engine, which crawls and collates the Semantic Web and provides services such as keyword-based searching for linked data. To reuse data sets and services above, two ontologies are used: Simple Knowledge Organization System (SKOS) and World Geodetic System 1984-based (WGS84) RDF vocabulary for geographical data.

The non-Semantic Services are: Map Services and Youtube data services. Map Services- that provides interactive mapping services from Google and Yahoo. Youtube data services-that finds videos via keyword-based search.

3.2.2. Application layer

Browser functionalities are divided into two groups as: Basic concept search and Advanced search. The basic concept search divides the concept into “Person”, “Event”, and “Place”. Searching by the name of a person-WorldHistory service is used, while searching by the name of place- GeoName service is used.

The advanced search supports searching videos by automatically analyzing documents, highlighting web contents, and pointing to locations on map- Zemanta service is used.

3.2.3. Semantic data mining and reasoning layer

There are four different types of mining and reasoning processes: syntax parsing, document analysis, geographic mapping, and annotation supposition.

Syntax Parsing: It is the basic reasoning process to match syntax-based keywords to a URI identifier from the Linked Open Data Cloud. For place syntax parsing the GeoName service is used and for event and person syntax searching the WorldHistory service is used.

Document Analysis: It is used to analyze a document that is used to guide the study topic. Zemanta service is used for documentation analysis task. The analysis results are key learning points, knowledge, and concepts with their URI identifiers from the Linked Open Data cloud.

Geographic Mapping: To give to the students a geographical image for better understanding the learning topic it uses the Google map API. The reasoning includes the map information used as the starting point to search for videos and other related learning resources, as well as parsing syntax or document analysis results to get the map.

Annotation Supposition: The annotation supposition process uses the tree-structure advantages of the ontology-based semantic annotations. By using the annotation reasoning process, the searching results are more accurate and widely covered.

3.3. Evaluation of Annotation Tool and Browser Platform

To evaluate Annotation Tool we have formed Experts and Tutors Evaluation Group (ETEG) and to evaluate Browser Platform Student Evaluation Group (SEG) is formed. Evaluation process has Four Steps:

3.3.1. Demonstration

For ETEG, one video as an example to show the annotation functionalities that use different Linked Data resources and web services. For SEG, how to use browser platform with both, basic concept search and advanced search.

3.3.2. Practice

ETEG to annotate a video and SEG to search the videos related to the topics that the ETEG annotated.

3.3.3. Evaluation

It has set of tasks includes simple activities and more advanced activities such as using two different URIs to annotate one concept in the video. Each task has a time limit. In this time limit it is monitored that each user's time spent on each of the task.

3.3.4. Feedback collection and analysis

Questionnaires are used to collect feedback from users for Annotation Tool and Browser Platform, inquiring about the quality, performance and usability of the tools.

Here, the whole Evaluation Method of Annotation Tool and Browser Platform are used to analyze the result of the evaluation task with Questionnaire's answers and measure the time taken for it.

IV. Conclusion

This paper shows Annotation tool and Browser platform uses Linked Data Technologies to semantically annotate and search educational video resources. In the semantic annotation process, annotation ontology is defined to support Linked Data annotations. In the semantic search process, the search methods are based on the data retrieved through Linked Data Services and URI's. Here Using Linked Data technology to annotate and search educational video resources has following advantages: Initial learning content management system is not needed to be changed. Accuracy of searching and collecting related learning resources due to the semantics of the annotations are processable by machines.

In future, also integrate Semantic Web Service technologies, such as dynamic service discovery, invocation and orchestration, to the applications for better usage of available Linked Data Services.

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