Semantic Multimedia Database Information Retrieval

1.0 Aims and Objectives

- Develop an indexing structure for semantic multimedia databases
- Develop a content-based query language for semantic multimedia databases
- Develop a visual interface for posing content-based queries to the semantic multimedia database

2.0 Proposed Plan of Work

a. Background

Multimedia data in traditional databases are stored in the form of raw alphanumeric data. Quite often we are interested in only certain information inside these raw data, for example, "What is happening within the media at time *t*? ". Since they are raw data, we cannot get it directly from the databases. Therefore, a new kind of database system, which I call semantic multimedia database, is needed that stores the semantic meaning of the raw data such that we are able to query the content of the data. In a semantic database, reference does not need to be made to the entire raw data but only to the selected content.

Multimedia semantics refers to the meaning depicted within videos, audios, and etc. and Semantic Multimedia Database (SMDB) systems are thus intended to integrate semantic information of a wide variety of formats, i.e. text animation, audio and video [1]. Agius and Angelides suggest a semantic content-based model that integrates syntactic and semantic information of multimedia [2,3]. It consists of a syntax m-frame (multimedia frames) layer and a semantic m-frames layer. A syntax m-frame of each frame's (video/audio) content is created to describe the syntactic content occurring within that frame. This is what is traditionally being stored in a database system. Semantic m-frames are generated based on syntax m-frames and a kind of object model that consists of three parts: description, events and actions, which describe the object, its activities and the events in which the object is engaged in. The proposed semantic database will be developed to accommodate the semantic m-frame.

Integrating multimedia information to a database has a great impact on its design and functions. If we only store multimedia as files, then a multimedia file server with pointers maintained by a relational database such as Oracle will be enough [4]. If more functions such as indexing, searching and querying based on semantics are required from the database, then new designs and techniques have to be developed. The design of this multimedia database requires [5]:

1. The SMDB conceptual model
2. Indexing structure and techniques
3. SMDB content-based query language
4. Visual interface for content-based information retrieval

b. Multimedia Information Retrieval from semantic multimedia databases

SMDB query language

In conventional database systems, in general, a query is formulated by knowing a database schema such as table definitions or a class hierarchy. Users must know the attribute structures or class structures in order to retrieve desired objects [6]. But multimedia data bring much more meaning than the traditional data. They place new requirements on retrieval systems. The data should be described in terms of their spatial, temporal and content information.

SQL is the most popular query language in the database world. With its simplicity and efficiency, it has been successfully used in relational databases. But it is hard to use it in other database systems, such as object-oriented databases. SQL3, aimed to add object-oriented extensions to the SQL-92 syntax, will not become an approved de jure standard before 1999 and it is hard to use [7]. Semantic queries, such as "Search for the video clip with Prince Andrew in the Andalusian costume", are impossible to perform in SQL. The answer of this is based on the contents of the data and their meaning. So a new multimedia query language or a new script language is needed to enable the user to pose such questions. The retrieval does not result in documents that contain the information but selected parts that match the meaning and the content.

Indexing for Semantic Multimedia Databases
The index is the most important map for locating semantic information in a SMDB. In traditional databases, multimedia data are indexed by the whole data name, e.g. “Video of Prince Andrew on the island”, because the database system stores the multimedia data as alphanumeric data and simply delivers blocks of data to the application upon request. It is simple and quick but it is not useful since data names only cannot represent the information that we are interested in. In fact, the multimedia raw data can be mapped by some means, like m-frames [2]. This feature is used in semantic databases, the information inside the multimedia data is indexed by those “semantic objects” (added to the databases) to locate the raw data.

With the m-frames, the information we are interested in is represented by a collection of three m-frames. They are: (1) Description m-frames which describes the entity of interest, (2) Events m-frames which model the events that are associated with the entity of interest, and (3) Action m-frames which model the constituent actions of the events modelled in the Events m-frames. Most segments of information are difficult to extract from single frames of video and audio (they have meaning over time and are also often meaningless when taken out of context) and it is not always possible to attribute events or actions based on a single frame. Therefore, each entity in m-frames will be given a set of frames (e.g. 104-151) to locate in the multimedia database. For example, if we have an ‘in the Andalusian costume’ segment at “Prince Andrew”: 104-151 and an ‘at a ball’ segment at “Prince Andrew” 33-145, Then we get “Prince Andrew”: 104-145 (=[104, 151]$\cap$[33, 145]) which has content of Prince Andrew in the Andalusian costume at a ball.

Visual interface for posing content-based Queries
On top of the proposed query language, a user interface, which can simplify human-machine interaction, needs to be developed for posing content-based queries. The user interface should accomplish visual interaction.

c. Applications

Semantic multimedia databases have far more advantages than the traditional databases in audio and video content requirements. Applications can benefit from SMDB because retrieval

does not result in whole audio/visual document retrieval and thus placing the task of meaning interpretation on the user, but the system is able to respond to specific content query [9].

d. Project Phases and Time scales

Time Table			
ID	Task Name	Starting Date	Ending Date
1	**Review and Background Reading**		
2	Multimedia introductory domain reading		
3	Multimedia databases reading and reviewing semantic retrieval		
5	**Build Up Semantic Multimedia Database**		
6	Build up the database prototype		
7	Set up the database model		
8	**Set Up Retrieval Model**		
9	Set up the retrieval model		
10	Build up query interface		
11	Build up query language transform mechanism		
12	Build up search mechanism		
13	Build up the presentation prototype		
14	**Test**		
15	Collect test results		
16	Modify the retrieval system accordingly		
17	**Writing up of Thesis**		

3.0 Resources

Essential Hardware: SGI O2 for development and testing of the SMDB & Information Retrieval
Essential Software: Programming language, (C++ or Java)
Databases for SGI O2

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